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INTRODUCTION

THE CHIEF OBJECTIVES of this paper are to present a systematic revision of the spider-wasp genus *Pepsis* as occurring in the Nearctic realm and to provide a conspectus of the genus dealing with such pertinent systematic information as seems necessary for the undertaking of future investigations. This procedure appears to be justified, since the genus has accumulated in its 150 years of recognition over 500 names, which at the present writing represent some 428 recognized species and which involve upwards of 200 published writings.

To accomplish these objectives, the study has been divided into five parts. The first part presents a historical review of the development of the generic concept of *Pepsis* and indicates the position of the genus within the family Pompilidae. The biology of the genus is reviewed in the second part. The third part deals with the distribution of the genus, with particular reference to the species discussed in the fourth part, in which the systematics of the Nearctic species are treated. The fifth part provides a summary of the names applied in the genus, with an indication of their nomenclatorial and taxonomic status.

The assistance and cooperation that have been afforded the author both in the accumulation of materials and in the preparation of the manuscript have been most gratifying. Nearly 10,000 specimens, principally from the Nearctic area, have been placed at my disposal. This has made possible the interpretation of the fauna through geographical analysis and has greatly aided in determining the levels of speciation which in several instances would not have been possible on morphological grounds alone.

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HISTORICAL REVIEW

AS EARLY AS the seventeenth century members of what is considered today as the tarantula-hawk genus *Pepsis* were mentioned in travelogues of voyages to the New World. Indeed, some specimens were collected with the express purpose of inciting astonishment among the friends of the voyager upon his return home. Gradually specimens began to accumulate, and eventually some found their way into scientific collections and were described. Réaumur (1742) appears to have provided the first figure of a species which we recognize today as belonging to the genus. He termed it a "guêpe ichneumon," a member of the "guêpe solitaires." This was subsequently named *Pepsis marginata* by Palisot de Beauvois in 1809 (1806–1821).

Later, when Linnaeus began to classify the manifold forms of life, he placed these "giant wasps," as they were frequently called, in the genus *Sphex*, a *potpourri* that included many other forms now regarded as quite divergent. The concept was narrowed somewhat by certain authors by aligning these wasps with what was to become the genus *Pompilus*, but most of the writers of this period adhered to the Linnaean concept of *Sphex*. Drury (1773) described and figured a species as *Sphex rubra*, which has been regarded as a species of the genus *Pepsis*. De Geer (1773) described a "guêpe ichneumon bleue à ailes dorées de Saint Domingue," as *Sphex auripennis*, a form which had been mentioned previously as "der Blaukörper." Christ (1791) characterized and illustrated as *Sphex* several species today regarded as *Pepsis*. Almost without exception all of our earlier named species were described and assigned to the Linnaean genus *Sphex*.

In 1805 Fabricius erected the genus *Pepsis* to include 47 species, many of which were described as new. These species were divided into two series, the first of which contained 27 species possessing the "abdomine petiolato," and the second series, or the "abdomine sessili," contained 20 species. Both of these series were grouped under the "Os lingua porrecta, trifida; labium apice membranaceum, emarginatum, utrinque seta suffultum; antennae setaceae." A somewhat more detailed description of the genus is to be

found later in the same publication. However, the chief characteristics of the genus so defined were sufficient to separate *Pepsis* from the other genera treated in the "Systema piezatorum." Fabricius did not designate a type for the genus, in spite of the allegations of Malaise (1937) and Schrottky (1909).

The writings of this period and up to the publications of Latreille (1809, 1810) are transitional in that both the Fabrician concept of the genus *Pepsis* and the Linnaean one of *Sphex* were utilized, depending on the individual author's inclinations. To some extent this confusion transcended the studies of Latreille. Notwithstanding, the Fabrician ideas concerning the division of the Linnaean *Sphex* were eventually accepted, and a more natural grouping of the various elements was achieved. It was chiefly the works of Latreille that brought an end to the variation in treatment with a more rigid definition of the genus and the designation of a West Indian species, *stellata* Fabricius, 1805, as the type of *Pepsis*. *Pepsis* was clearly separated by Latreille from the other three genera of "Pompiliens," *Pompilus*, *Ceropales*, and *Aporus*. The first series, or the "abdomine petiolata" of Fabricius, was dismembered and distributed in other genera.

Dahlbom (1843–1845) through the employment of wing venational characters, principally the point of union of the first recurrent nervure with the cubital vein of the second submarginal cell, narrowed the generic limits even more by excluding certain of the species placed by Fabricius in the "abdomine sessili" series, which have the first recurrent nervure uniting with the cubital vein of the second submarginal cell at or beyond the middle. Lepeletier (1845), apparently working independently and with no advance knowledge of Dahlbom's treatment, similarly defined the genus and described a number of new species, none of which bears the same name as those proposed by Dahlbom. The genus was placed with three other genera in his "Tribu Pepsites." The treatments of Blanchard (1845), Spinola (1851), F. Smith (1855), and Cresson (1867) do not appear to differ appreciably in concept from those of the preceding two authors, even though generic diagnoses were

not always included. The Taschenberg (1869) definition of the genus is similar to that of Dahlbom and Lepeletier, differing chiefly in the utilization of secondary sex characters, a matter further amplified by Kohl (1884) in his generic study of the pompilid genera. Burmeister (1872) adopted without any serious deviation the concept as formulated by Taschenberg, as did Mocsáry (1885) and Cameron (1893). Fox (1894b) proposed a classification for the family Pompilidae in which the genus was placed in a most unharmonious grouping of unrelated genera under the tribe Pompilini. Even so, the generic concept remained as previously defined.

The excellent treatise entitled "Die Pompiliden Gattung-*Pepsis*" by Lucas (1895) has served as the basis for almost all modern interpretative studies on the genus. The generic diagnosis therein presented has clearly set the limits of the genus. Perhaps the most useful generic character noted by him and later enlarged upon in a separate paper (1919) is the rounded apex of the marginal cell and its apical recession from the costal margin of the wing. Many of the characters mentioned in the generic description by this author serve as useful guides in placing the genus within the spider-wasp family Pompilidae and have been utilized in later classifications for defining the higher categories. The monograph presents the knowledge of the genus in a most masterful fashion through the medium of modern taxonomic descriptions and keys. Many new species were described, and a good majority of previously described species were re-described from the original type specimens. The species were divided among groups which were given notations and are still recognized today in one fashion or another in studies of infrageneric relationships. The taxonomic treatment, as in the past, utilized color as its chief criterion, but departed from the usual color diagnosis in that morphological differences expressed by the genitalia, the subgenital plate, the shape of the third submarginal cell, the sculpture of the propodeum, and the nature and placement of the vestiture were drawn upon for supportive characters. A section devoted to the biology of the genus presents, in nearly unabridged form, all the information on this subject

known at that time. Distributional generalizations form a separate portion of the monograph, wherein it is forcefully shown that the genus is strictly American. Certainly with the inclusion of bibliographical citations to each of the species previously described, and a terminal bibliography, the work must stand as the most comprehensive yet written on the genus.

During the years immediately following the appearance of this work descriptions of new species and faunal papers of local scope were published. Quite clearly the beginnings of the broad outlines on the distribution of the genus within the Americas were initiated. Fox (1897) reported the results of a study of the pompilid fauna of Brazil. This was followed by a treatment of the American species of *Pepsis* occurring north of Mexico by Fox (1898) and later by Banks (1921). Brèthes (1909b) summarized the Chilean fauna, and in 1908 began his studies by describing some 46 species as new, principally from Argentina, Brazil, and Paraguay. In 1914 Brèthes published his "Contribution à l'étude des *Pepsis*." In this work some 34 species are characterized as new. A key to the recognized species of the genus is presented, and notes upon previously described species, particularly those of South American occurrence, are included. An important discussion dealing with the geographical dispersal of the genus forms his concluding remarks.

In 1919 the Lucas revision of the genus was published, and while it contains much useful information it is not so masterfully presented as was his monograph. Apparently difficulties growing out of World War I postponed an earlier attempt at publication, for only the earlier paper of Brèthes (1908) was fully incorporated and only portions of the later paper (1914) were included. Even so, the importance of the paper must not be underestimated, since the author's philosophical approach in matters of distribution, taxonomy, morphology, and classification of the genus have had a profound influence upon subsequent workers. As mentioned above, the group concept reaches its culmination in this publication, and types are designated for each group of species. However, only the *gigantea* group was accorded full subgeneric recognition, the remaining groups, despite their type

designations, being left simply as species groups. In essence the Lucas paper is a group by group review of the species, accompanied in most instances with tabular analyses and infused with such original and published information as had come to his attention since 1895. In many respects the paper is an invaluable contribution to the knowledge of the genus.

Since 1919 the systematic investigations on *Pepsis* have consisted to a large extent of descriptive works, faunal papers, or synonymical studies. This trend was only recently deviated from in an important paper on the South American species of the genus by Banks (1946) in which the preliminary subgeneric studies reported by that author in 1945 were enlarged upon and applied to the vast assemblage of species occurring in the southern continent. These findings are summarized in the fifth part of the present paper, since it is now quite evident that any future study based upon the genus, as a whole or in part, must have a guide to the voluminous and scattered literature.

Attempts have been made from time to time by various authors since the turn of the century to express the relationships existing among the categories of the family Pompilidae. Ashmead (1900a) divided the Pompilidae into six subfamilies and later (1900b) removed the genus *Pepsis* from the Fox (1894b) tribe Pompilini and placed it, with 15 other genera, in the newly erected subfamily Pepsinae. Banks (1912) further

divided this subfamily and erected the tribe Pepsini for the reception of the genera *Cryptocheilus*, *Myrmecosalius*, *Pepsis*, and *Priocnemoides*. Haupt (1927), in his monograph of the European pompilids, has somewhat modified the subfamily Pepsinae and includes therein the genera *Calicurgus*, *Cryptocheilus*, *Mygnumia*, *Pepsis*, *Priocnemoides*, and *Priocnemis*. It appears that Banks in subsequent writings (1934, 1944a, 1944b, 1945) has rather consistently accorded full subfamily rank to the genus, a fact emphasized by Bradley (1944). Brimley (1936) included *Pepsis* with four other genera in the tribe Pepsini. Bradley (1944) placed the genus in the monotypic tribe Pepsini, which is included with the tribes Calicurgini, Cryptocheilini, Hemipepsini, and Pseudageniini in the subfamily Pepsinae, *sensu* Ashmead. Banks (1946) in his most recent classification assigns to the Pepsinae both the genus *Pepsis* and a monotypic genus, *Abripepsis*, described for the reception of a new South American species. The Dreisbach (1948) classification is essentially that of Bradley (1944) wherein *Pepsis* is placed as the sole member of the Pepsini. It would appear to this writer that the interpretation of the relationships existing within the subfamily Pepsinae as proposed by Ashmead and defined more recently by Bradley (1944, p. 2) seems to approximate the most natural grouping; for, as Bradley opined, the categories of this subfamily appear to be products of differentiation within a single developmental line.

BIOLOGY

RELATIVELY LITTLE is known concerning the life histories of these spider-wasps, in spite of the attention they have attracted from the naturalist and the laity alike. Since it was first learned that the female wasp attacks mygalomorph spiders, a considerable effort appears to have been made to record the antics of the wasp and spider during their encounter. As a consequence of these observations the rather appropriate "tarantula-hawk" vernacular has been applied to members of the genus *Pepsis*, and tales of their encounters with the spiders have been retold many times.

Thomas Say (1824) in his remarks on the genus *Pompilus*, *sensu lato*, seems to have been the first to observe a species of the genus *Pepsis* "dragging along the ground the body of the gigantic bird-catching spider, the *Mygale avicularia*, or a closely related species." Buckley (1862) described at some length the struggle between a tarantula determined as *Eurypelma hentzii*, and *Pepsis formosa* in Texas. He states that the tarantula-killer often effects paralysis of the tarantula and then drags the spider into a burrow previously excavated, deposits an egg, and covers the burrow. Lincecum (1867), with apparently the same two species as participants, records in somewhat more detail a similar encounter which he observed in central Texas. This account differs significantly from that of Buckley in that the wasp was observed to drag the spider to "some suitable place" and then excavate a hole some 5 inches in depth. The sting of the wasp was reported not to kill the spider; rather it paralyzes the spider. He also stated that an odor is produced by the wasp which in some instances attracts other female tarantula-hawks. On these occasions a fight ensues between the wasps, which may end with both of the wasps succumbing, or one is driven off while the other takes possession of the prey. He indicates that several other species of large ground spiders are pursued, but that *Mygale hentzii* is preferred. Finally, Lincecum tells of a tarantula that succeeded in capturing a wasp which was trying to attack it.

Walsh and Riley (1869, pp. 111, 128-129) quoted the Buckley and Lincecum accounts

and figured a specimen of *Mygale hentzii* and of *Pepsis formosa*. With Peabody (Peabody, Walsh, and Riley, 1869, p. 52) they reported the depredations of *Pepsis formosa* on a grape vineyard in Glenwood, Missouri. Entire bunches of grapes were destroyed, leaving the remains to honey bees which attended or closely followed the wasp. McKenzie (1933, p. 159) observed similar damage inflicted on bunches of muscat grapes by two species of *Pepsis* at Twentynine Palms, California. In this last case control measures were undertaken in the form of poisoned fruits and liquid baits, but they met with little success.

Stelle (1870, p. 238), in discussing the tarantula fauna of Tennessee, mentions that he found but one species, *Mygale hentzii*, and attributes its rare occurrence as possibly resulting from the work of the tarantula-hawk, "*Pepsis formosa*," which is reported by that author to be common in Tennessee. Darwin (1875, p. 35) recounts the contest between undetermined species of *Pepsis* and "*Lycosa*" in the vicinity of Rio de Janeiro. The wasp was observed to sting the spider twice on the under surface of the thorax. As the wasp began to drag the spider away, Darwin intervened and separated the "tyrant and prey."

Riley (1887, p. cclxix) commented on a tarantula exhibited at the November 19 meeting of the Academy of Science of St. Louis received from Santa Barbara, California. The spider was determined as *Mygale hentzii*, and Riley stated that wherever this spider occurred it was followed by a peculiar "digger-wasp, *Pepsis formosa*," which preyed upon it. In answering a communication received from a correspondent in Springer, New Mexico, Riley (1889, pp. 148-149) identified some wasp specimens received in an accompanying parcel as the Texan digger wasp or hornet, *Pepsis formosa*, and remarked concerning the biology of the wasp that its egg was inserted into the body of the prey, *Mygale hentzii*.

McCook (1890, pp. 384-385, 414) quoted a portion of the Lincecum report and stated that in his opinion there is no doubt that the terrible digger wasp will be found to store trapdoor spiders as well as tarantulas and lycosids. To his cognizance there was no evi-

dence to suggest that *Pepsis formosa* invades the tunnel of the Mygalidae in order to dig them out. However, he did not believe that such is beyond her powers.

Laboulbene (1895) gives a description of a wasp, *Pepsis formosa*, and a tarantula, *Eurypelma hentzii*, which were obtained in San Francisco, California, from a dealer. As near as could be ascertained the pair appeared to have come originally from southern California, probably from the environs of Santa Barbara. There is but little doubt that the wasp was a representative of the Stål species *Pepsis mildei*, and that the tarantula was most likely an *Aphonopelma*. A communication from a Dr. Simon is also cited by Laboulbene wherein a blue species of *Pepsis* was observed trailing a eurypelmid in Venezuela.

Kellogg (1914, p. 501) and Annixter (1934, p. 24) reported *Pepsis* dying from the effects of "poisonous wounds" inflicted by the chelicerae of the tarantula spider which itself had succumbed to the wasp's sting.

In a paper on the bees of the Coronado Islands, Cockerell (1916, p. 55) records having seen *Pepsis formosa* (rectius *Pepsis thisbe*) preying upon a "tarantula" species believed to be *Avicularia californica*. Poulton (1918, p. xxxvi) records an undetermined spider of the genus *Idiops* as having been captured by an unnamed species of *Pepsis* at Piracicaba, Brazil. Rau and Rau (1918, pp. 67-71) tell of a most interesting encounter between *Pepsis dubitata* (= *Pepsis elegans*) and a spider in the vicinity of St. Louis, Missouri. The wasp was first observed to enter an abandoned rodent burrow and reappear some 30 feet away with the spider. Whereupon the wasp struggled over some 300 feet of terrain and disappeared with the prey into another rodent hole. However, an excavation of the burrow failed to reveal either the wasp or the spider. Ruiz (1923a, p. 101), in recording *Pepsis limbata* from Cerro San Cristobal, Chile, mentioned that this species has commonly been observed battling with the spider *Phryxotrichus chilensis*, with which the wasp provisions its nest.

A series of carefully planned and conducted laboratory experiments, supplemented by field observations, were carried on in Puerto Rico by Petrunkevitch (1926) with *Pepsis marginata* and several families of spiders. The

experiments were devised to study in detail the encounter between the wasp and spider, to observe the mode of recognition of the prey species, the methods of attack and defense, the dangers therein incurred, the frequency of failure, the disparity in size existing between the wasp and spider, the inadequacy of weapons, and the effect of the sting upon the spider.

Petrunkevitch learned from witnessing over 200 encounters both in cage experiments and in the field that this wasp detects the presence of the spider by sight rather than by smell, that her actions are deliberate, and that the wasp and spider behave in each instance in the same manner, except that the wasp maintains a remarkable independence of varied conditions suggestive of a degree of intelligence. He reports that in no case does the wasp display "fear," and if "angered" or in danger the wings are raised and at the same time a pungent odor is emitted which may serve either for self protection or as a warning. Petrunkevitch rules out the sense of smell in that searching for the spider the wasp notices and then closely approaches her victim, an act apparently regarded as an unnecessarily dangerous one, especially since this routine is followed in examining other Arachnida. Moreover, the examination is not dependent upon the condition of the ovaries, since the wasp frequently examines other tarantulas placed before her shortly after the deposition of an egg.

According to Petrunkevitch, *Pepsis marginata* appears to be host specific on *Cyrtophilus portoricae*, a fact that was established both in the laboratory and in the field. The wasp discriminates among spiders in the laboratory by tapping them with her antennae, climbing upon the back of the spider, or by slipping under the spider. Under natural conditions the wasp searches out the burrow of *Cyrtophilus* by flying low over the terrain.

The wasp approaches the prey from any direction, grasps her adversary with her mandibles on either the first or the fourth leg, and by anchoring her claws against those of the spider bends her abdomen until the sting is inserted into the membrane between the sternum and the carapace. No particular portion of this area is selected, but it appears that the poison acts quickest when introduced into the

anterior end of the sternum which seems to offer easy access to the thoracic ganglion. Paralysis is almost instantaneous and complete, causing cessation of heart action; however, the limbs remain sensitive to stimulation. Once the sting is removed, the wasp cleanses herself, and should the spider exhibit any further movement the sting is again inserted for a considerably longer period. Frequently the wasp was observed to feed on the body fluids which exuded from the wound initiated by the sting.

Possession of a discriminating faculty with regard to the paralyzed spider on the part of the wasp is suggested by the fact that when a recently paralyzed spider is removed and one paralyzed several days previously is introduced, the wasp desists from burying the substitute. The "grave" may be prepared in advance of the encounter or afterwards. Once the spider is paralyzed it is dragged to the site and introduced into the burrow. The wasp remains for a considerable length of time within the burrow, and it is suggested that during this period oviposition and the firm packing of soil around the spider takes place. The packing of the soil is apparently necessary to insure retention of the spider should it recover and dig its way out during the early developmental stages of the wasp. Once the wasp emerges from the burrow, she is careful to obliterate virtually all traces of her deed.

In all of the encounters studied by Petrunkevitch, the wasp was never observed to have been injured or killed, even when the paralyzed spider was removed and an active one placed in its stead. The biological equilibrium between this species of *Pepsis* and its prey is thought to be maintained by the greater number of eggs laid by the spider in comparison to that of its enemy. Petrunkevitch suggests that another factor in the maintenance of the balance may be the relative inaccessibility of the spider once it is at the bottom of its burrow, where it can offer an impregnable portion of its body to a wasp seeking it out. Petrunkevitch provides two very excellent plates of photographs which pictorially depict the encounter between the wasp and the spider and its consummation.

In studying the trapdoor spider, *Bothriocyrtum californicum*, in San Diego County, California, Passmore (1933, pp. 203, 205)

found that the spider was attacked by *Pepsis mildei*. This author observed that when hunger induced the spider to capture prey by daylight, she would respond to any vibration caused by an organism walking over the ground. Occasionally, the wasp would be mistaken for the "usual sow bug," and the spider would open the trap door only to fall victim to the wasp. In the ensuing struggle the spider is paralyzed, and since the door to her nest is open the wasp drags her victim back into the burrow and deposits an egg upon her. Whether or not the entrance to the burrow is sealed in any way by the wasp was not indicated. When eclosion of the egg occurs, the larva bores into the body of the spider and consumes the tissues, being careful not to attack the vital organs. At pupation, Passmore found that the wasp larva spins a silken cocoon which is suspended above the skeletonized remains of the spider.

The editors of Nature Magazine have reproduced in rotogravure a series of exceptionally well-executed photographs of a life history study made by Passmore (1936, pp. 155-159) on *Pepsis mildei* (reported as *Pepsis formosa*). These photographs, together with a verbal description based upon the observations recorded by Passmore, describe sequentially the encounter between the wasp and a tarantula (?=*Aphonopelma*), its culmination, and certain of the developmental stages of the wasp. Passmore reported that the spider was attacked outside the entrance of its burrow, paralyzed by the sting which was inserted at a point just beneath the second leg, and turned over on its back, where, if any further movement occurred, the wasp would again insert her sting until all activity on the part of the spider ceased. After complete paralysis, the spider was dragged into its own burrow. Upon excavating the burrow the following day, Passmore found the entrance to have been sealed with earth, leaves, and other unspecified matter. The spider was located near the end of the burrow chamber, lying on its back. A careful examination failed to reveal the egg of the wasp. A similar, if not the same, photographic series, with the omission of the cocoon and the adult wasp upon a floral head, were presented in the Illustrated London News (Passmore, 1937, pp. 404-405).

In table 1 a summary of the known host

TABLE 1
SUMMARY OF THE KNOWN HOST RECORDS FOR THE GENUS *Pepsis*^a

Wasp	Spider	Locality	Authority
<i>Pepsis</i> sp.	<i>Mygale avicularia</i>	United States	Say, 1824
	<i>Mygale hentzii</i>	Tennessee	Stelle, 1870, p. 238
	<i>Lucosa</i> sp.	Brazil	Darwin, 1875, p. 35
	<i>Eurypelmid</i>	Venezuela	Laboulbene, 1895, p. 181
	<i>Brachythele longitarsis</i>	California	Smith, 1908, p. 229
	<i>Idiops</i> sp.	Brazil	Poulton, 1918, p. xxxvi
	<i>Eurypelma</i>	California	Annixter, 1934, p. 24
	Undetermined	Missouri	Rau and Rau, 1918, p. 67
	<i>Mygale hentzii</i>	Texas	Buckley, 1862, p. 138
	<i>Mygale hentzii</i>	Texas	Lincecum, 1867, p. 137
<i>elegans</i> <i>formosa</i>	<i>Eurypelma hentzii</i>	Texas	McCook, 1890, p. 384
	<i>Mygale</i> sp.	United States	Kellogg, 1914, p. 501
	<i>Phryxotrichus chilensis</i>	Chile	Ruiz, 1923, p. 101
	<i>Cyrtophilus portoricae</i>	Puerto Rico	Petrunkévitch, 1926, p. 390
<i>limbata</i> <i>marginata</i> <i>mildei</i>	<i>Eurypelma hentzii</i>	California	Laboulbene, 1895, p. 181
	<i>Bothriocyrtum californicum</i>	California	Passmore, 1933, p. 205
	? <i>Aphonopelma</i> sp.	California	Passmore, 1936, p. 155
	? <i>Aphonopelma</i> sp.	California	Passmore, 1937, p. 404
	<i>Aphonopelma</i> sp.	California	New record
	<i>Mygale</i> sp.	Brazil	Burmeister, 1872, p. 232
<i>reaumuri</i> <i>thisbe</i>	? <i>Avicularia californica</i>	Mexico	Cockerell, 1916, p. 55
	<i>Aphonopelma</i> sp.	California	Gertsch, 1949, pls. 12, 17

^a Names of the wasps changed to agree with present concepts.

records for the genus *Pepsis* is presented. Included is a new record for *Pepsis mildei* which was obtained from a photograph taken at Vista, San Diego County, California, by Dr. T. W. Fisher at the conclusion of an encounter between the wasp and a male *Aphonopelma* which was kindly determined for the writer by Dr. Willis J. Gertsch. It appears to me that additional studies similar to that of Petrunkévitch (1926) are needed to establish such matters as the taxonomic level of the spider preyed upon by the wasp, whether or not all species of the genus are catholic in their choice of host, and also to establish the influence of the sex of the host spider upon the production of the sexes of the wasp. It is to be hoped that specimens providing additional prey records will be subjected to more careful determination than those that are recorded in the literature under the name of *Mygale* or *Eurypelma hentzii*, a name that in the words of Gertsch (*in litt.*) shows that "there was a time when almost any tarantula was labeled *Mygale hentzii*." Gertsch states further that "the list of spiders [table 1] re-

flects the systematics of the era, but . . . it is probably safe to regard Say's *Mygale avicularia* as being only *hentzii*; the same is also true of the Texas records for that species but certainly not true for *Eurypelma hentzii* from Santa Barbara." Gertsch concludes with the statement that "my inclination would be to disregard the specific names completely and use instead *Dugesiella* sp. for all the records east of the Rocky Mountains and *Aphonopelma* sp. for anything from west of Arizona." With regard to the Cockerell record (1916, p. 55) of *Avicularia californica* from the Coronado Islands, Gertsch believes that "it is quite correct inasmuch as a species of that genus has been reported from southern and Lower California, but . . . the record of *Mygale hentzii* in Tennessee [Stelle, 1870, p. 238] must have been one of the very large wolf spiders." As with the host records, many of the records of *Pepsis* reported as *Pepsis formosa* are open to serious question, since that name has been used for virtually every species of *Pepsis* known to occur in the Nearctic area.

Scarcely any information on the early developmental stages of the genus has been published. Cresson (1865, p. 133) has described the cocoon of *Pepsis marginata*, stating that it "is elongate-ovate, $2\frac{5}{8}$ inches long by $1\frac{1}{8}$ inch wide about the middle, gradually tapering at one end, constructed of a rather thin, hard woody substance, of a yellowish-brown color, more or less mottled or stained with blackish." Emergence of the wasp is accomplished by means of a circular incision about one-fourth of the distance from the tapered end forming a cap or lid. Petrunkevitch (1926, p. 380) has described the egg of the same species as "of the type common to wasps and bees, but considerably larger (4.7 mm. long, and 8.2 grams in weight), and translucent white." Passmore (1936) has observed that when the wasp larva has consumed all but the inedible portions of the spider, it leaves the remains and crawls along the floor of the burrow chamber to a point where construction of the cocoon is to be made. There the construction is initiated by attaching some "floss" to the walls of the burrow. Spinning of the cocoon is accomplished by passing the threads of silk around the larva itself until it is completely enclosed. Passmore presents two very excellent illustrations of the cocoon, one showing it *in situ*, and the other showing the details of the cocoon by dissection. The "half-grown" wasp larva is revealed to be encased within extremely smoothly polished walls, thereby permitting freedom of movement.

The genus *Pepsis* is apparently quite immune to attack by other organisms. Danforth (1931) and Wetmore (1916) have, however, recorded the capture and eating of two different West Indian species of *Pepsis* by kingbirds. Poulton (1918) has reported the reduviid bug, *Apiomerus lanipes*, taking an undetermined species of *Pepsis* at Piracicaba, Brazil. Dr. H. E. Evans of Kansas State University (*in litt.*) has observed the robber fly, *Saropogon dispar*, capture and sink its proboscis into a specimen of *Pepsis thisbe* which had been feeding on the sap exuding from a willow. Other individuals of *Saropogon* were observed to be lurking about the tree.

A number of suffrutescent and woody flowering plants, especially those characteristic of the chaparral or forest edge, are

visited by the wasps in search of nectar. Names of many of these plants have been given in the papers of Lincecum (1867), Ruiz (1923a), Jaffuel and Pirion (1926), Wolcott (1936), and Hurd (1948). The list of floral records for the genus, including those obtained during the course of this study, is quite extensive and contains representatives of over 30 plant families. However, there seems to be a certain degree of preference for the nectar obtained from flowers of the milkweed genus *Asclepias*, a fact noted by Lincecum (1867) and stressed by Hurd (1948). While it is difficult to ascertain the degree to which this preference is exhibited by the genus as a whole, it is the opinion of this writer that it is a significant relationship. Many of the visitations occurring on plants other than *Asclepias* appear to be of an incidental nature and usually of rather short duration. On the contrary, any one who has observed the wasps congregating on the milkweed is aware of the ease one has in capturing these otherwise wary wasps. The role thought to be assumed by the genus *Pepsis* in the pollination of the milkweed has been emphasized in a previous paper (Hurd, 1948). Indirect evidence obtained through the observation of the *Asclepias* pollinia clinging to the tarsi and mouth parts of the wasp specimens studied in the preparation of this paper continue to support the contention that these wasps may prove to be one of the most important pollinators of the milkweed.

Williams (1928, p. 143) has recorded observations on an orange-winged species of *Pepsis* in the vicinity of Guayaquil, Ecuador, during the period preceding nightfall. He found that the wasps seemed to exhibit "a sort of communal instinct for resting."

Several papers have appeared on the subject of mimicry in which species of the genus *Pepsis* have been reported to be mimicked by species belonging to the orders Diptera, Hemiptera, Lepidoptera, and Orthoptera. Howard (1902, p. 136) records the mydaeid species, *Mydas luteipennis*, of Texas and New Mexico, and *Pepsis formosa* as exemplifying "a case of aggressive or protective mimicry" owing to their similar appearance and geography. Kaye (1913) figures a number of instances of similar-appearing insects and attempts to demonstrate that *Pepsis vene-*

zuelae is mimicked by a syntomid moth, *Macrocneme adonis*, both of which occur together in the wooded ravines of the coast range mountains near Caracas, Venezuela. This author discusses the similarities exhibited by the moth and wasp both in appearance and in the modes of flight. An equivalent example is cited for another species of the syntomid genus *Macrocneme* and an unnamed species of the "marabunta" or spider-wasp genus "*Salix*" observed in Brazil. Poulton (1913a, 1913b) displayed before the Entomological Society of London a wasp determined as *Pepsis saphirus*, the model, and three of its purported mimics, the reduviid

bug, *Zelurus lepeletieranus* (= *Spiniger ater*), the syntomid moth, *Macrocneme*, and the locustid, *Scaphura nigra*, var. *vigorsii*. These had been received from Brazil where they were taken by a Dr. Seitz "along not more than two hundred paces of a sunny road through the high forest between Santos and São Vicente." The latter had observed them together in all months of the year and stated that the mimics assume, both in flight and at rest, quite similar attitudes to those of the wasp. Williams (1928, p. 143) avers to these earlier accounts and mentions that he had been "deceived for a moment by this mimicry."

DISTRIBUTION

THE GENUS *Pepsis* occurs exclusively in the New World, being found on both the North and South American continents and also on the majority of the West Indian islands. The known geographic range of the genus is quite large, extending from Santa Cruz, Argentina, near latitude 47° S. for *Pepsis euterpe* (Brèthes, 1914, p. 350), to Logan, Utah, just south of latitude 42° N. for *Pepsis thisbe*. Within the geographic range, members of the genus occur at elevations ranging from below sea level to 11,000 to 12,000 feet in the higher Andes of South America. A similar degree of geographic plasticity is to be found in its occurrence in such diverse ecological situations as coastal, river basin, and interior desert localities. The greatest number of described species are recorded from Brazil and more particularly from the political state of Minas Gerais. Our knowledge of the geographic distribution of the genus in terms of species per unit area is presented in an accompanying map of the Americas (fig. 1) and in table 2.

Brèthes (1914, pp. 350–355) has discussed the distribution of the genus in terms of the species groups defined in the primary divisions of the keys presented by Lucas (1895) and has provided a distributional map which attempts to show the pattern of dispersal from the purported center of origin, Minas Gerais. Brèthes believed the genus had its origin in this region of Brazil and spread chiefly to the north. This author reasoned that the evolution of *Pepsis* was initiated by a great pluvial period brought about by the evaporation of the Atlantic Ocean following its formation by the submergence of the hypothetical continent Archhellenis. This period of great rainfall was supposed to favor an enormous increase and an accompanying diversity in the vegetation which in turn permitted a similar increase in the phytophagous insects upon which a spider fauna evolved. Brèthes states that *Pepsis* evolved "dans la même mesure des Araignées, leur proie." As a corollary, he pointed to the relatively poorly developed *Pepsis* faunas to be found along the more arid regions fronting on the Pacific coast.

Lucas (1919, p. 5) stated that in his opinion the genus was developed in the

"jüngste Erdperiode." He based this conclusion of recent origin on the large number of species and on the degrees of morphological divergence expressed within the genus. To him, the morphological characters appeared to be but poorly developed; however, colorational features, particularly those of the wings, exhibited surprisingly important differences, a condition that he held to be indicative of recent origin.

The known geologic history is meager. Burmeister (1832, p. 636) has reported an undescribed species of *Pepsis* from the Baltic Amber of the Lower Oligocene, comparing it with a "*Pepsis lutaria*." It is quite evident that this fossil is not a representative of the genus *Pepsis*, owing to the markedly pedicellate character of the abdomen. Moreover, the species with which it was compared is not a *Pepsis*, having been referred to the sphecine genus *Podalonia* by several workers. Cockerell (1941, pp. 355–356) has figured and described *Pepsis avitula* from the Miocene (Oligocene?) shales of Florissant, Colorado. This appears to be the first authentic fossil of the genus thus far discovered.

The Nearctic *Pepsis* fauna represents the northern terminus of the genus. Within this northern periphery (fig. 2) 15 species are now known to occur, three of which are geographically ditypic. The species are divisible into two chromatic series on the basis of wing coloration: the melanochromatic series, which includes *elegans*, *mexicana*, *saphirus*, and *venusta*; and the xanthochromatic series, to which the following species are assignable: *angustimarginata*, *aquila*, *arizonica*, *azteca*, *cerberus*, *chrysothemis*, *marginata*, *mildei*, *pallidolimbata*, and *thisbe*. One additional species, *formosa*, is both geographically ditypic and dichromatic, *formosa*, *sensu stricto*, being xanthochromatic and *pattoni* melanochromatic. With but one exception, the xanthochromatic series is of western distribution, occurring chiefly to the west of the 100th meridian. The one xanthochromatic species, *marginata*, of eastern distribution is primarily West Indian but has been found on the southern portion of the Florida peninsula. The melanochromatic series is about equally divided geographically, with two species,

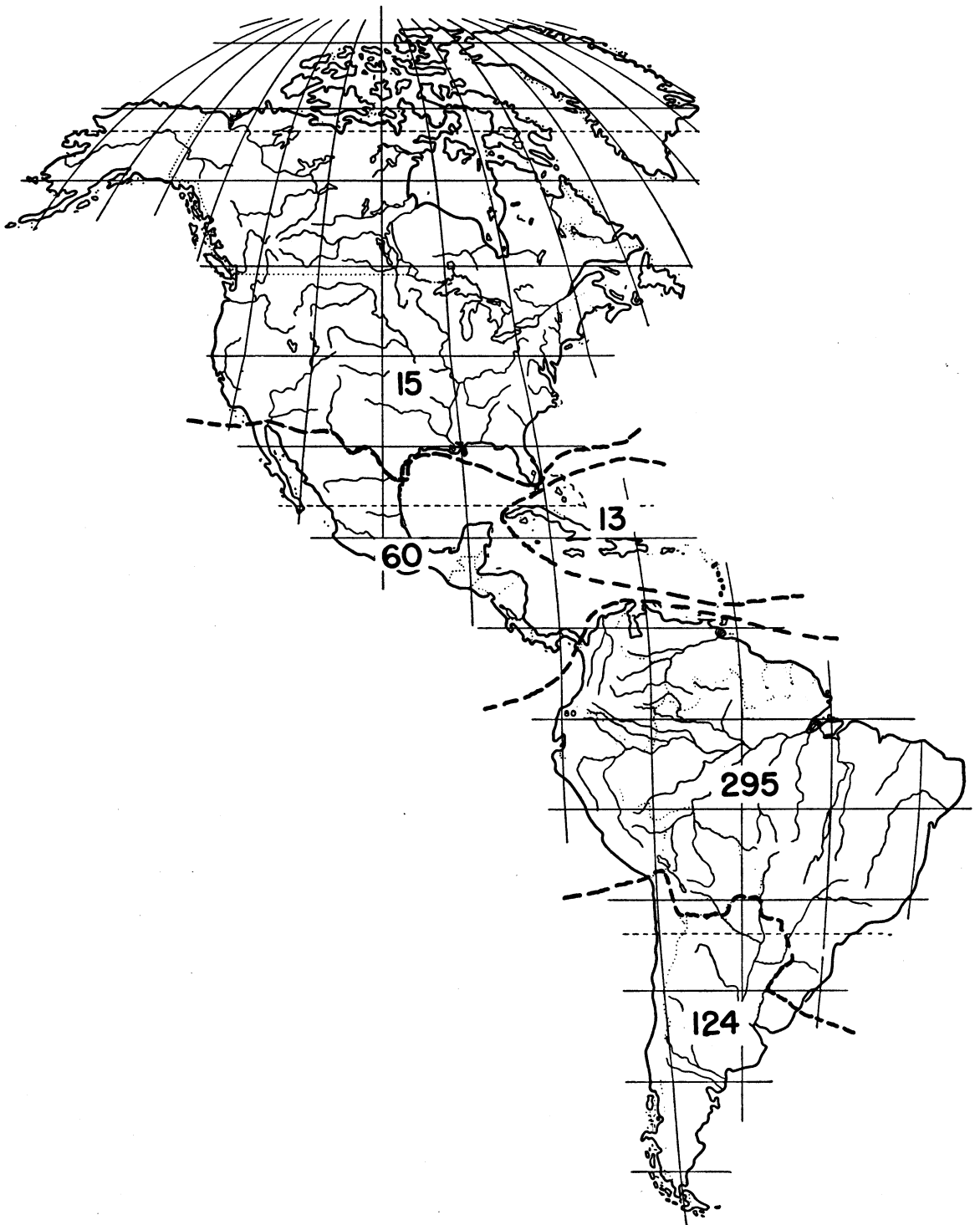


FIG. 1. Numerical distribution of the species of *Pepsis*.

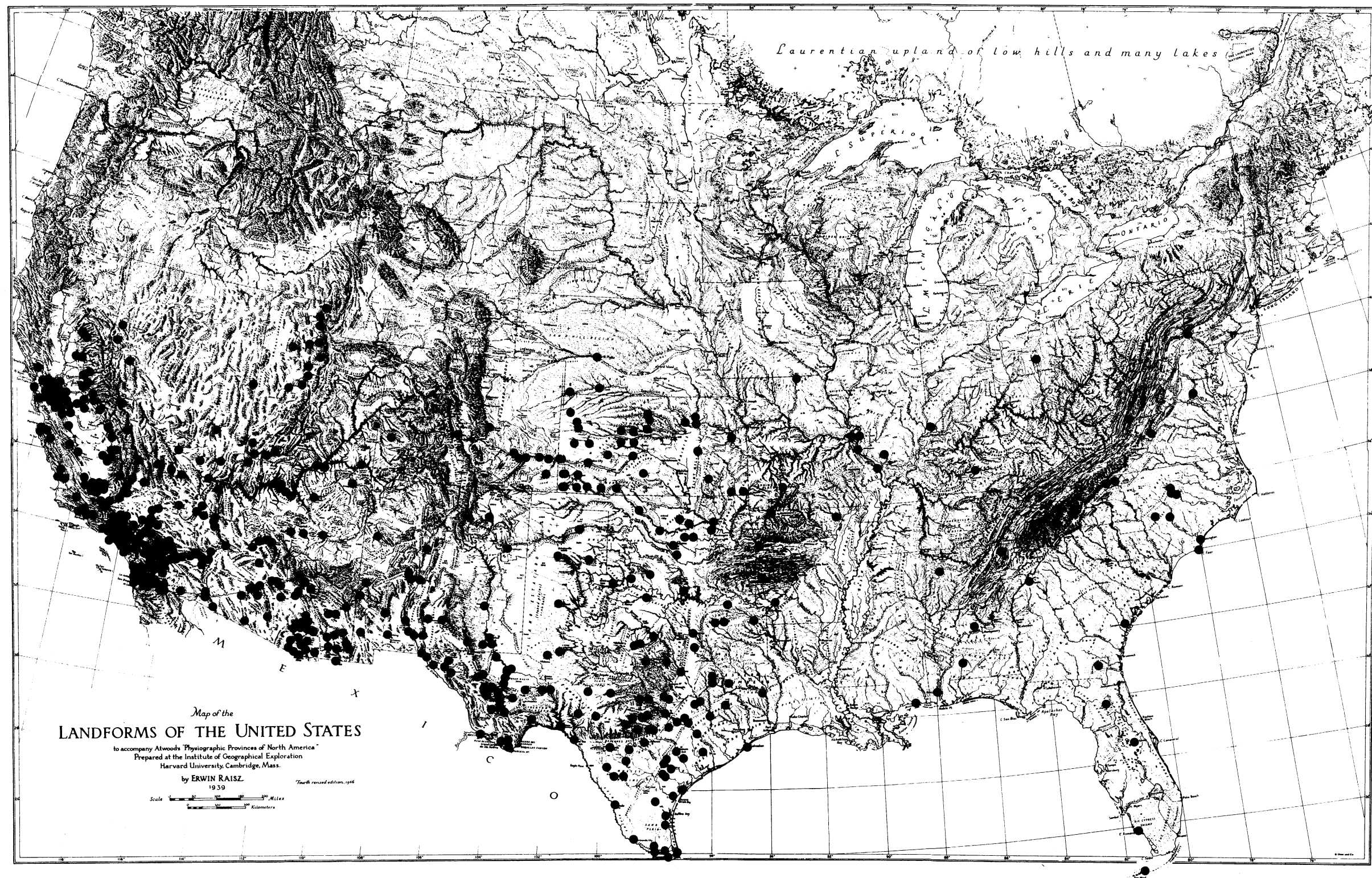


FIG. 2. Distribution of the genus *Pepsis* in the Nearctic area.

TABLE 2
NUMBER OF SPECIES PER POLITICAL REGION

	Number of Species	Male Only	Female Only	Both Sexes	Sex Unknown
Argentina	101	45	25	30	1
Bolivia	39	6	17	16	—
Brazil	203	57	83	63	—
British Guiana	33	2	12	19	—
British Honduras	2	1	—	1	—
Chile	7	—	2	5	—
Colombia	52	9	17	25	—
Costa Rica	7	2	—	5	—
Ecuador	27	6	11	10	—
El Salvador	1	—	—	1	—
French Guiana	15	2	8	5	—
Guatemala	12	3	3	6	—
Honduras	4	3	—	1	—
Mexico	35	6	7	22	—
Nicaragua	5	—	1	4	—
Panama	25	6	8	11	—
Paraguay	42	13	11	18	—
Peru	44	10	20	14	—
Surinam	16	2	7	7	—
Trinidad	20	4	6	10	—
United States	15	2	—	13	—
Uruguay	8	2	1	5	—
Venezuela	23	2	7	14	—
West Indies	13	3	3	6	1
Country unknown	15	5	8	1	1

elegans and *saphirus*, of eastern distribution, and with *venusta*, *mexicana*, and the subspecies *formosa pattoni* of western distribution.

The genus is represented in the eastern United States by one widespread species, *elegans* (fig. 45), which is supplanted on the southern tip of the Florida peninsula by two West Indian species, *marginata* and *saphirus*. Of the 12 western species, three (*aquila*, *azteca*, and *venusta*) are known from only a few extreme southern localities within the United States and are apparently members of a more southern fauna which has its center of distribution in Central America or northern South America. The northern distributional peripheries of three additional species (*arizonica*, *mexicana*, and *cerberus*) seem to indicate that their centers of distribution are also to the south, probably in central or northern Mexico. The remaining six species appear to have their centers of

distribution within the Nearctic area. Of this last group, *formosa*, *sensu lato*, is unique in that morphologically it is very closely related to the species of the subgenus *Dinopepsis* and may ultimately prove to be a part of a single highly geographically polytypic species, *grossa*, of northern South America.

Thisbe appears to be the most widespread and the most abundant species of *Pepsis* occurring in the Nearctic region (fig. 46). Moreover, in many respects it presents the most plastic, geographically non-segregable variation exhibited by any of the Nearctic species of the genus. A striking example of this is to be found in the relatively high incidence of males with melanistic wings, a condition that has been noted in three other species (*cerberus*, *chrysothemis*, and *mildei*), but so infrequently as to be considered rare. In addition, the subgenital plate of the male *thisbe* assumes a number of configurations (fig. 3) that seem suggestive of incipient

morphological change. Comparative studies of the other species reveal that, among those species possessing a subgenital plate apically traversed by carinate processes, *thisbe* possesses an intermediate type, and it may be that any significant future speciation in the Nearctic area may arise through the fixation of any one or more of these now very incipient morphological variants of this species.

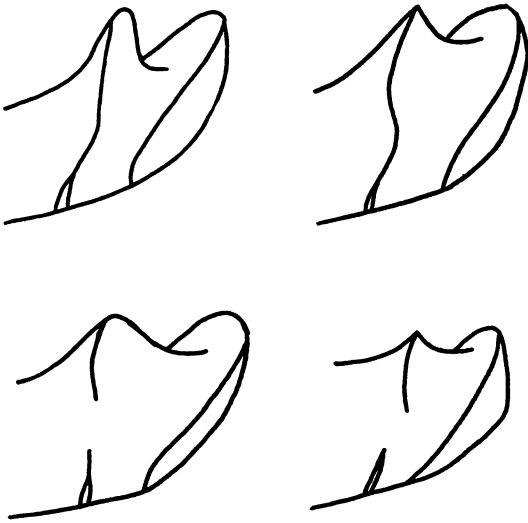


FIG. 3. Profile views of the subgenital plate of *Pepsis thisbe*.

Three of the western Nearctic species (*chrysothemis*, *formosa*, and *pallidolimbata*) are each geographically ditypic. The characters of each of the pairs of subspecies involved are geographically segregable, but the degree of difference existing between them when contrasted with other species of the genus clearly indicates that they were very recently derived. Empiricism suggests that the *formosa-pattoni* subspecies pair is the oldest of the three, followed by that of the *chrysothemis-lucasii* pair and then that of *pallidolimbata-smithi*. Oddly enough, the areas of intergradation for the subspecies of each respective ditypic species are in widely sepa-

rated geographic regions and do seem to be correlated with the degree of morphologic divergence expressed when the relative geologic ages of these areas are considered.

The remaining two western Nearctic species, *angustimarginata* and *mildei*, bear such a close morphological relationship that one is led to believe they arose from the identical ancestral stock. *Mildei* appears to retain the greater degree of variability and, as is noted in the discussion of that species, there is a tendency towards differentiation on the extreme western periphery of its distribution. *Angustimarginata* and *basifusca*, a species occurring in northern Mexico, may be conspecific, as suggested in the discussion of *angustimarginata*. If, however, the morphologic characters are segregable geographically, as seems to be the case, then it would appear that *angustimarginata* and *basifusca* bear subspecific relationships, since the expression of characters is indeed subtle.

The eastern Nearctic species, *elegans*, and its western counterpart, *cerberus*, are quite closely related. Their distribution is allopatric, with a relatively broad area of overlapping distribution (fig. 45) in which an intermediate form appears. The intermediates thus far seen are constant in their colorational characteristics, possessing the orange antennae of *elegans* and the xanthochromatic wings of *cerberus*. An examination of both sexes of this intermediate form reveals no structural differences, and, in the absence of evidence suggesting a gradient of intermediate types, the parental species, *cerberus* and *elegans*, are assumed to have attained partial but incomplete genetic isolation. In comparison with other species of *Pepsis* the morphologic divergence of these two species is not so complete but is certainly greater than the morphological expressions present in the three ditypic species. It would be extremely interesting to know whether or not an intergrading series between *cerberus* and *elegans* exists and also to know the degree of fertility possessed by the known intermediates.

SYSTEMATICS

GENUS *PEPSIS* FABRICIUS

Pepsis FABRICIUS, 1805, *Systema piezatorum*, pp. 207–208. PALISOT DE BEAUVOIS, 1806, *Insectes recueillis en Afrique et en Amérique*, p. 37. LATREILLE, 1809, *Genera crustaceorum et insectorum*, vol. 4, pp. 61–62; 1810, *Considérations générales . . . des insectes*, pp. 61, 437; 1825, *Familles naturelles du règne animal*, p. 455. BLANCHARD, 1840, *Histoire naturelle des insectes*, vol. 3, p. 355. DAHLBOM, 1844–1845, *Hymenoptera Europaea*, pt. 1, pp. 119, 463. LEPELETIER, 1845, *Histoire naturelle des insectes, hyménoptères*, vol. 3, p. 470. BLANCHARD, 1845, *Histoire des insectes*, vol. 1, p. 93. SPINOLA, *in* Gay, 1851, *Historia física y política de Chile, Zoologia*, vol. 6, pp. 372–375. CRESSON, 1867, *Trans. Amer. Ent. Soc.*, vol. 1, p. 143. TASCHENBERG, 1869, *Zeitschr. f. d. Gesammt. Naturwiss.*, vol. 34, pp. 26–27. BURMEISTER, 1872, *Stettiner Ent. Zeitg.*, vol. 33, pp. 230–232. KOHL, 1884, *Verhandl. K. K. Zool.-Bot. Gesellsch. Wien*, vol. 34, pp. 37, 46–47. MOCSÁRY, 1885, *Termész. Füzt.*, vol. 9, pp. 236–239. CRESSON, 1887, *Trans. Amer. Ent. Soc.*, suppl. vol., p. 111. CAMERON, 1893, *Biologia Centrali-Americana, Hymenoptera*, vol. 2, p. 15. FOX, 1894, *Proc. Acad. Nat. Sci. Philadelphia*, vol. 46, pp. 296, 297. LUCAS, 1895, *Berliner Ent. Zeitschr.*, vol. 39, pp. 449–474. ASHMEAD, 1900, *Canadian Ent.*, vol. 32, p. 185. BRÈTHES, 1909, *Bol. Mus. Hist. Nat. Valparaíso*, vol. 13, p. 202. BANKS, 1912, *Jour. New York Ent. Soc.*, vol. 19, p. 223. BRÈTHES, 1914, *An. Mus. Nac. Hist. Nat. Buenos Aires*, vol. 26, pp. 236–237, 350–355. LUCAS, 1919, *Arch. Naturgesch.*, div. A, vol. 83, no. 5, pp. 1–2, 5–13, 166–173. BANKS, 1919, *Bull. Mus. Comp. Zool., Harvard Coll.*, vol. 63, p. 230. HAUPT, 1927, *Deutsche Ent. Zeitschr.*, suppl., pp. 26, 27. BANKS, 1934, *Proc. Amer. Acad. Arts Sci.*, vol. 69, p. 3. BRIMLEY, 1936, *Jour. Elisha Mitchell Sci. Soc.*, vol. 52, pp. 112, 118. MALAISE, 1937, *Ent. News*, vol. 48, p. 132. BRADLEY, 1944, *Notulae Nat., Acad. Nat. Sci. Philadelphia*, no. 145, p. 8. BANKS, 1945, *Bol. Ent. Venezolana*, vol. 4, p. 81; 1946, *Bull. Mus. Comp. Zool., Harvard Coll.*, vol. 96, pp. 315–316. HURD, 1948, *Univ. California Publ. Ent.*, vol. 8, p. 123.

Pepis KLUG, 1848, *Reisen in Britisch-Guiana*, vol. 3, p. 588 (*lapsus pro Pepsis* Fabricius, 1805, p. 207).

Marginal cell rounded apically, its extreme apex well separated from costal wing margin; first recurrent nervure received by cubital vein of second submarginal cell before its basal third, at which point the cubital vein

is obtusely angled; first discoidal cell usually considerably shorter than first submarginal cell, its apex not surpassing that of the first submarginal cell; tarsal claws unidentate within.

TYPE: *Pepsis stellata* Fabricius [i.e., *Sphex stellata* Fabricius, 1793, p. 219], by subsequent designation of Latreille (1810, p. 437).

Salman (1929) has made a detailed morphological study of *Pepsis elegans* with the view to evaluate critically the various structural features of taxonomic value and also to learn the degree of variation expressed by any one character. An attempt was also made by this author to standardize the descriptive terminology in order to establish uniformity of application in systematic considerations of the genus *Pepsis*. Since this work embodies the morphological investigations of such writers as Staveley (1862), Radoszkowski (1888), Lucas (1895, 1919), Snodgrass (1909), and Bugnion (1932) these are not repeated here. The present writer has adopted with minor modifications the morphological terminologies suggested by Salman.

To a large degree the earlier descriptive writings were based almost exclusively on colorational features, which of course was a natural consequence, since relatively few specimens of any species were available, and the differences so expressed appeared to be quite diagnostic. However, as more material became available, particularly of a single species, it became evident that colorational characteristics alone were insufficient. Moreover, it was soon learned that the intensity of coloration, a character that had been used to distinguish species, was not constant, but changed with the age of the specimens or was altered by mechanical damage incurred by the insect under natural conditions. Smith (1855), Cresson (1867), and Cameron (1893) all made reference to certain morphological modifications of the propodeum, which at the time of description were important contributions. Nevertheless, the number of described species became so large that by the time Lucas (1895) monographed the genus such characters were practically meaningless and required a restudy of all the available

types. Lucas, while still relying largely on colorational differences, did, however, endeavor to utilize many previously neglected structural characters. These were principally the genitalia, the subgenital plate, and certain propodeal features. Brèthes (1908, 1914) returned almost entirely to the use of color, while Fox (1898), Banks (1921, 1928, 1946), and Salman (1929, MS), to mention a few, basically followed Lucas in attempting to utilize structural characteristics of already proved value and also investigated the possibilities of newly discovered characters.

Colorational features do offer very excellent diagnostic characters, provided the range of variation is known for any character. Since this is not always possible to ascertain, it appears that color should be accorded a secondary or subordinate role in interpretative studies. This conclusion seems almost inescapable in view of the present studies, which have clearly demonstrated the existence within a single population of opposite or convergent color forms, which by themselves very strikingly resemble other wholly unrelated species. As an example, *Pepsis cerberus* normally possesses predominantly xanthochromatic wings, yet male specimens have been studied that have the wings deeply infuscated throughout with black and thus appear to belong to those species normally possessing melanochromatic wings. Indeed, the superficial resemblance to males of *Pepsis mexicana* is so close that it is possible to consider them as such until an examination of the structural characters is made. These remarks are equally applicable to melanistic males of *thisbe* which also superficially resemble *Pepsis mexicana*. On the other hand, when a normally xanthochromatic species such as *mildei* exhibits melanochromatic wings, it so closely approximates the normally melanochromatic *Pepsis elegans*, a species of similar morphology, that a misidentification is quite easily made. Another type of colorational convergence has been noted for the males of the normally xanthochromatic species *Pepsis chrysothemis*, a Nearctic species, and *Pepsis sanguigutta*, a West Indian species. In this example the subspecies *lucasil* of *chrysothemis* exhibits the very nearly identical wing coloration and pattern exhibited by *sanguigutta*. Indeed, the

correspondence is so close that when the two are intermingled in a single series, identification is virtually impossible without recourse to structural characteristics. This same type of convergence also has been noted between a male specimen of *Pepsis cerberus* and males of *sanguigutta*. In this instance, however, the two species are even more widely separated in morphological relationships.

Perhaps the most diagnostic color characteristics of the wings are the nature, extent, and placement of the exterior marginal and submarginal dark bands. This is particularly true of those species possessing xanthochromatic wings, since those species which normally possess melanochromatic wings are either uniformly infuscated throughout or have the extreme exterior marginal areas of one or both pairs clearly, or very nearly, whitish hyaline. In general, there is little if any lack of correspondence between the sexes in the extent or placement of these bands. However, in the xanthochromatic species, *chrysothemis*, there is an important sexual difference in this respect. The forewings of the male are, at the extreme apex, very distinctly though narrowly whitish hyaline, while the apices of the female wings are uniformly dark and indistinguishable from the coloration of the exterior marginal dark band. The xanthochromatic species *angustimarginata*, *aquila*, *arizonica*, *azteca*, *cerberus*, *marginata*, and *mildei* have the dark band in both sexes confined to the exterior marginal wing area, while the remaining Nearctic xanthochromatic species, *formosa*, *sensu stricto*, *pallidolimbata*, and *thisbe*, have the dark band in both sexes confined to the exterior submarginal area and have the narrow exterior marginal area whitish hyaline or nearly so.

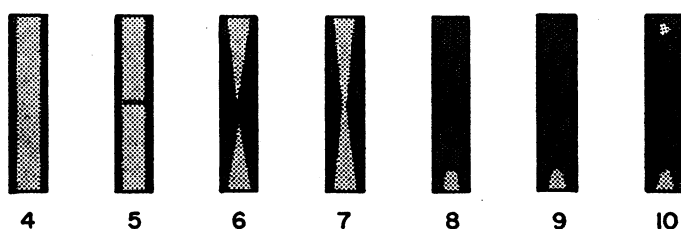
Differences in the relative widths of these dark bands exist between the species, but because the range of variation exhibited by any one of the species overlaps that of other species the taxonomic usefulness is limited. Differences are also present in the relative widths of the humeral wing bands of the various xanthochromatic species, but as is the case with other colorational features of the wings, they are subject to multi-modal variation.

Attempts to describe definitively the wing

colors or their composite colorational appearance, even with the aid of color standards, are almost hopeless. As has been previously pointed out, the coloration of the wings is apparently due to the combined colorational features of the wing itself, the minute tomentose hairs, and the effulgence of either or both of these. Thus newly emerged specimens tend to be deeper in coloration than those that have been exposed to various physical or environmental influences. Nevertheless, color differences do exist between species, even though the translation of these differences

range of variation is superimposed upon that of its host, the spider. Thus a species that one is led to regard as generally of medium size may actually contain variants ranging from those assignable to small-sized species to those assignable to large-sized species. To be sure, these size differences are real, but their diagnostic value is limited.

The vestiture of the body and appendages may be very diagnostic; this is particularly true in the case of the females. As an example, the fore femora of the *formosa* female are provided with long, bristle-like hairs on their



FIGS. 4-10. Antennal flagellar segments, showing types of sensorial areas exhibited by the Nearctic species of *Pepsis*.

into descriptive terms is not entirely satisfactory.

Lucas (1895, 1919) and to some extent Fox (1898) and Banks (1946) have utilized the shape of the third submarginal cell for distinguishing species. However, at least in the species of the Nearctic area, this character is wholly untenable, for complete gradational variation between any two "types" is easily demonstrable.

The color of the iridescent body tomentum and its relative density have been used to separate certain species. Here again, the variation so expressed, normal or otherwise, cannot be relied upon for differentiation, unless the range of variation is known. One Nearctic species, *pallidolimbata*, and more particularly its nominate subspecies, most frequently exhibit a very characteristic appearance; even so, it is imperative that other diagnostic characters be considered in their determination. Equally unreliable are statements concerning the size of any given species, unless these dimensions are expressed in relative terms. Each species impressionistically appears to present a certain characteristic size difference, but these differences are not expressible, except in relative terms, for the

under surfaces. Even if these fore femoral hairs are lost, their former presence can be ascertained through an examination of the integumental surface. The females of *angustimarginata* and *arizonica* likewise possess femoral hairs of taxonomic value. The relative density of the body vestiture is important in comparative studies, but is of little or no value diagnostically.

Of the appendages of the head, the antennae possess the more important characters. The male flagellar segments possess usually at least one sensorial area per segment. The placement and shape of these areas are very diagnostic. The majority of our Nearctic *Pepsis* males have the broad-band type of flagellar sensoria (figs. 4, 5), while others have the sensorial area in the form of opposing isosceles triangles (fig. 6), which in some instances fuse at their apices to form a constricted-band type (fig. 7). Still others have the sensorial area basal (figs. 8, 9) or basal and apical (fig. 10). These areas are highly differentiated and of characteristic shape. All the known Nearctic females exhibit flagellar sensoria arranged in very broad bands similar to those of the males of the broad-band type (fig. 4). The length of the

first flagellar segment of the female antennae compared to the distance between the eyes at the level of the posterior ocelli furnishes important distinguishing differences in the female. The color of the antenna frequently provides clues to the identity of a species, but, as noted elsewhere, the range of variation in certain species indicates caution of application. The comparative segmental lengths of the labial and maxillary palpi are useful only when used in conjunction with other characters. Similarly, the relative size of the anterior ocellus as compared with the posterior ocelli exhibits differences that are useful as supportive characters. Configurations of the anterior clypeal margin have been used in characterizing species, but since this structure is subject to mechanical wear its value is limited. One of the more useful characters of the head is the occipital carina. In some species it attains the preular suture, and in others it terminates considerably before the suture. Thus when considered with other characters in the aggregate it is most useful.

The degree of development of such thoracic structures as the pronotal shoulders and the mesopleural and propodeal tubercles furnishes excellent characters for the separation of the females. Lucas (1895, 1919) has attached considerable importance to various propodeal modifications, especially the carinate and striate sculpturings, but the present writer is inclined to de-emphasize them, since all degrees of expression are to be found within a single species. There is no question that differences exist, but the degree of development of these characters is apparently wholly dependent upon the size of the particular specimen and therefore their usefulness is of subordinate taxonomic significance.

Vague references have frequently been made to the spines and serrations of the tibiae and tarsi. While certain species, such as females of *arizonica* and *cerberus*, possess very pronounced differences in this respect, the majority of the species differ but slightly and then only in the degree of expression. The length of the inner tibial spur of both the middle and hind legs as contrasted with the length of the respective basitarsi supplies a very diagnostic character. Notwithstanding, attempts have been made all too

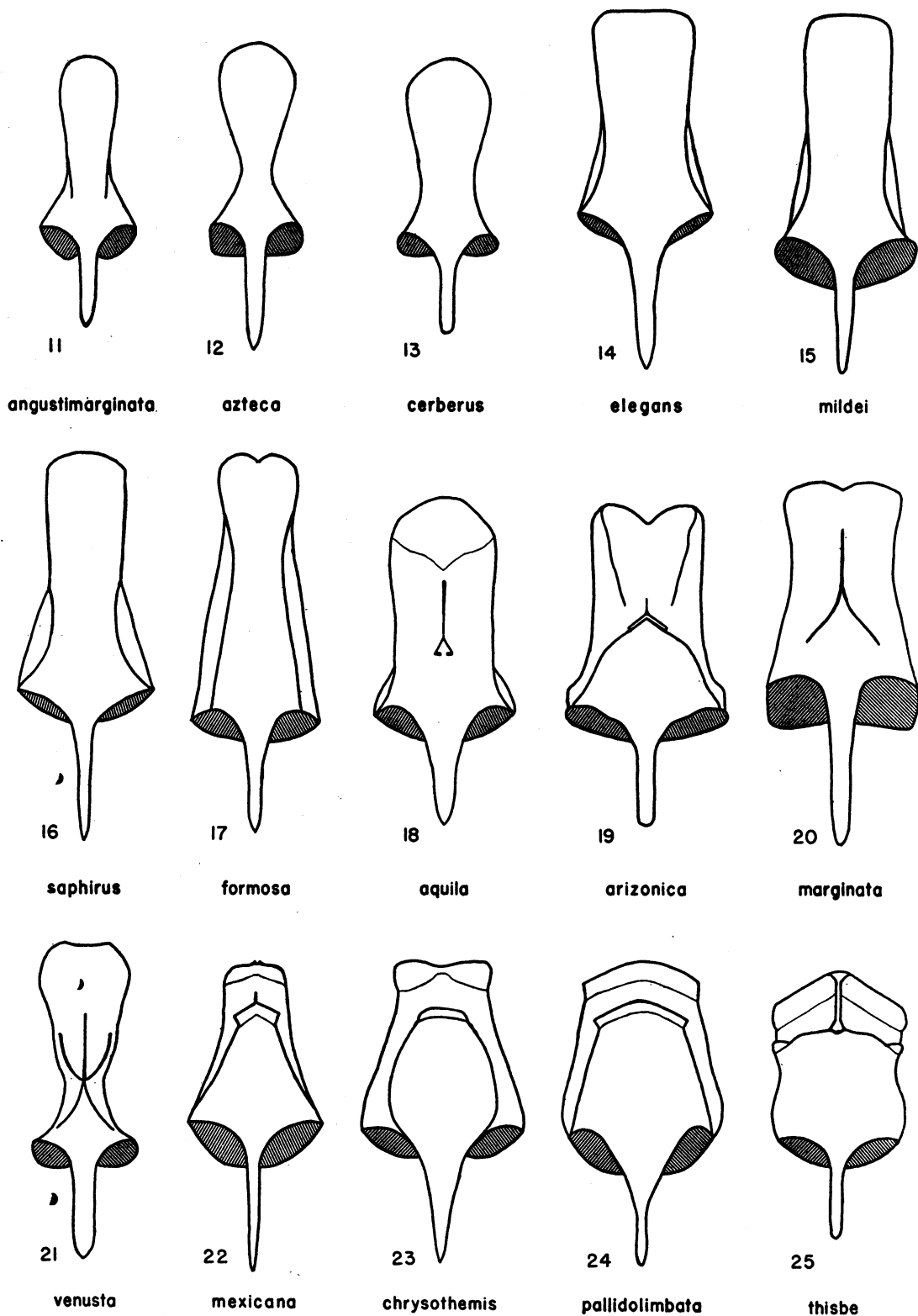
frequently to place too much emphasis on too small mensural differences. The outer tibial spur in conjunction with the inner tibial spur may be modified, as in the females of *elegans* and *cerberus*, and exhibit some very striking differences. In these last-named species the spurs are curved, with their apices nearly hooked.

The abdomen of the female presents almost no usable morphological characters. While it is true that certain indefinable differences are present, they are so subtle that their usefulness is very limited. The abdomen of the male, however, provides some very excellent characters. The most important of these are the subgenital plate, the genitalia, and the ventral abdominal hair brushes. Perhaps the most salient feature is the subgenital plate which when used either by itself or in conjunction with certain structures of the genitalia is sufficiently diagnostic to permit identification of any of our known Nearctic species. The various configurations assumed by the subgenital plates are indicative of certain evolutionary trends that are expressed by such structures as the volsella and gonostylus of the genitalia. Those species that possess in the male the ventral abdominal hair brushes provide still another additional character of considerable diagnostic value, since the brushes themselves are modified both in extent and nature.

KEY TO THE NEARCTIC SPECIES OF *Pepsis*

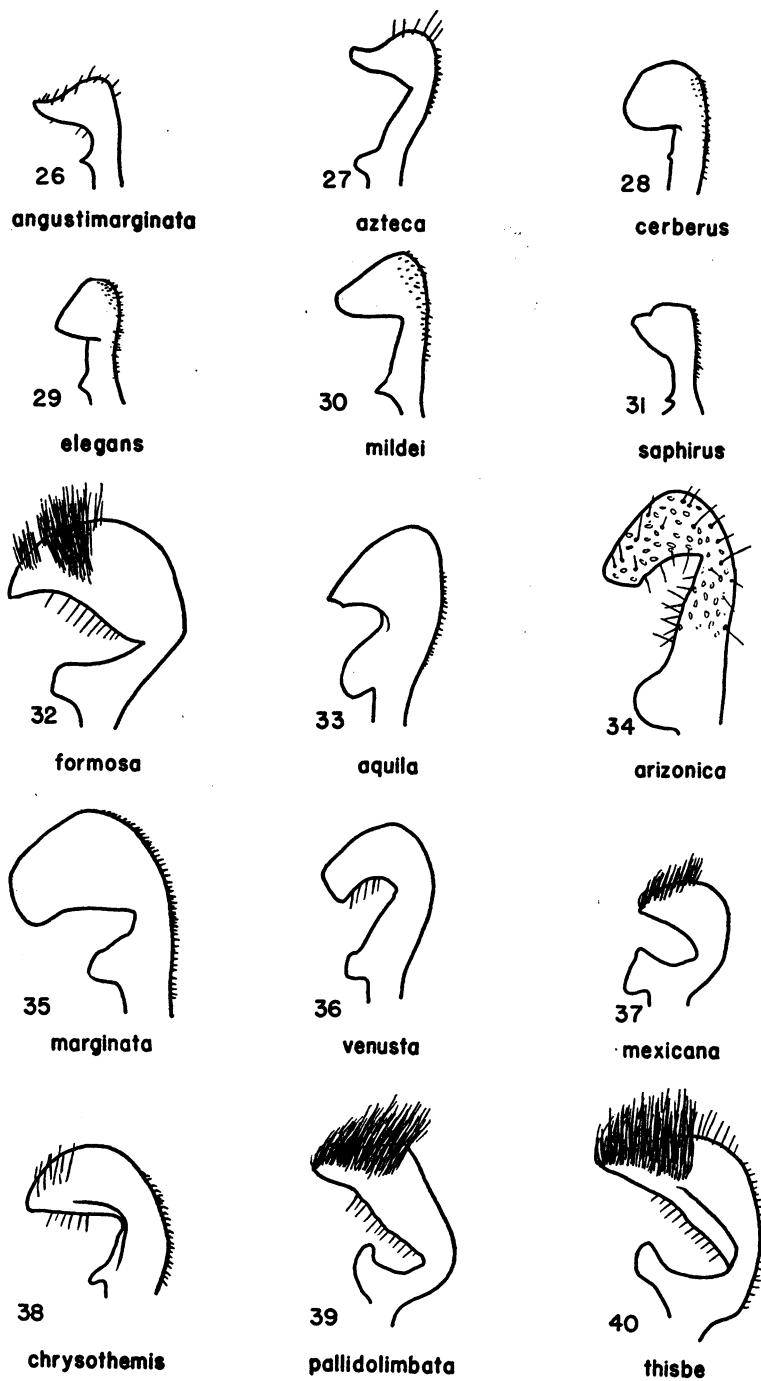
1. Males (antennae not convolute; abdomen with seven visible segments) 2
- Females (antennae convolute; abdomen with six visible segments) 19
- 2(1). Antennae 12-segmented; subgenital plate forming an elongate trapezoid, narrowing posteriorly, clothed densely with very long, erect, bristle-like hairs (fig. 17); vestiture of gonostylus of similar nature 3
- Antennae 13-segmented; subgenital plate never forming an elongate trapezoid, never clothed as above, glabrous, or clothed with fine, short pubescence; vestiture of gonostylus short 4
- 3(2). Wings predominantly xanthochromatic *formosa formosa* (p. 285)
- Wings predominantly melanochromatic *formosa pattoni* (p. 287)
- 4(2). Fourth abdominal sternite and sometimes the fifth with densely compacted

- bristles or hairs forming hair brushes; subgenital plate more or less spatulate, never with transverse, longitudinal, or dentate processes on ventral surface (figs. 11-16) 5
- Fourth and fifth abdominal sternites without densely compacted bristles or hairs; subgenital plate variously modified, but always bearing transverse, longitudinal, or dentate processes (figs. 18-25) 10
- 5(4). Fourth abdominal sternite with bristles strongly reflexed near their apices . 6
- Fourth abdominal sternite with bristles not strongly reflexed at their apices. 8
- 6(5). Antennal flagellar sensoria small, basal (rarely apical), triangular or hemielliptical, depressed, markedly differentiated from surrounding integument (figs. 8, 9, 10); wings predominantly xanthochromatic 7
- Antennal flagellar sensoria large, basal and apical, most frequently in form of opposing isosceles triangles (fig. 6), or of constricted-band type (fig. 7); wings wholly melanochromatic *saphirus* (p. 287)
- 7(6). Fourth and fifth abdominal sternites each with densely compacted bristles or hairs; antennae with at least apical segment tipped with orange, frequently several or all flagellar segments orange *mildei* (p. 288)
- Fourth abdominal sternite with densely compacted bristles or hairs, fifth with a few scattered hairs; antennae wholly dark *angustimarginata* (p. 291)
- 8(5). Fourth abdominal sternite with two obliquely arranged rows of caudally directed bristles, which when viewed from above present a hemispherical outline on their anterior margin; fifth abdominal sternite glabrous, or very nearly so 9
- Fourth and fifth abdominal sternites each with densely compacted, erect, undifferentiated bristles or hairs, which when viewed in profile are seen to slope posteriorly owing to progressive decrease in length of hairs *azteca* (p. 293)
- 9(8). Wings predominantly xanthochromatic, rarely melanochromatic; antennal flagellar segments brownish black, or black, rarely orange *cerberus* (p. 294)
- Wings wholly melanochromatic; antennal segments orange *elegans* (p. 295)
- 10(4). Subgenital plate with a medio-longitudinal carina or a median basal carinate process, apical margin without a transverse carinate process (figs. 18-21) . 11
- Subgenital plate without a medio-longitudinal carina or a median basal carinate process, apical margin with a transverse carinate process (figs. 22-25) 14
- 11(10). Subgenital plate strongly arched downward 12
- Subgenital plate flat, or very nearly so. 13
- 12(11). Antennal flagellar sensoria small, hemielliptical, depressed, markedly differentiated from surrounding integument (fig. 8); wings predominantly melanochromatic *venusta* (p. 298)
- Antennal flagellar sensoria broad, band-like (fig. 4); wings predominantly xanthochromatic . *marginata* (p. 299)
- 13(11). Subgenital plate deeply emarginate at apex (fig. 19) *arizonica* (p. 300)
- Subgenital plate not emarginate at apex, apical margin nearly hemispherical in outline (fig. 18) *aquila* (p. 302)
- 14(10). Subgenital plate with apical and subapical transverse carinae, no subapical median tooth (figs. 22-24) 15
- Subgenital plate with apical transverse carina and low subapical transverse carina which extends laterad on either side of blunt, subapical, median tooth (fig. 25) *thisbe* (p. 303)
- 15(14). Subgenital plate with subapical carina much less than width of subgenital plate, strongly arcuate or angulate (figs. 22, 23) 16
- Subgenital plate with subapical carina extending nearly to lateral margins of subgenital plate, not strongly arcuate or angulate (fig. 24) 17
- 16(15). Wings lemon yellow to yellowish brown; iridescent tomentum of head, body, and legs with greenish sheen *pallidolimbata pallidolimbata* (p. 307)
- Wings reddish brown to fiery red; iridescent tomentum of head, body, and legs with dark blue-green sheen *pallidolimbata smithi* (p. 308)
- 17(15). Subgenital plate with subapical transverse carina evenly arcuate (fig. 23); wings predominantly xanthochromatic 18
- Subgenital plate with subapical transverse carina strongly angulate at middle (fig. 22); wings predominantly melanochromatic *mexicana* (p. 308)
- 18(17). Forewings with exterior submarginal dark band narrow, considerably less than length of first and second flagellar seg-



FIGS. 11-25. Male subgenital plates of the Nearctic species of *Pepsis*.

- ments taken together
 . . . *chrysothemis chrysothemis* (p. 312)
- Forewings with exterior submarginal dark band broad, greater than length of first two flagellar segments taken together
 *chrysothemis lucasii* (p. 313)
- 19(1). Anterior femora below clothed with very long, bristle-like hairs 20
- Anterior femora below glabrous, or at most with a few short hairs 22
- 20(19). Anterior femora below clothed with very long, bristle-like hairs, middle and hind femora glabrous or nearly so; middle and hind tibiae without anterolateral or posterolateral longitudinal grooves 21
- Anterior, middle, and hind femora clothed with very long, bristle-like hairs; middle and hind tibiae each with an anterolateral and a posterolateral longitudinal groove extending nearly the length of tibia *arizonica* (p. 300)
- 21(20). Wings predominantly xanthochromatic
 *formosa formosa* (p. 285)
- Wings predominantly melanochromatic
 *formosa pattoni* (p. 287)
- 22(19). Spurs of middle tibiae acutely curved near apex 23
- Spurs of middle tibiae not acutely curved near apex, straight or only slightly curved 24
- 23(22). Hind tibia armed on entire posterior surface with very long, apically curved bristles; wings predominantly xanthochromatic; antennal flagellar segments brownish black or black, rarely orange *cerberus* (p. 294)
- Hind tibia armed only on upper third of posterior surface with very long, apically curved bristles; wings wholly melanochromatic; antennal flagellar segments orange *elegans* (p. 295)
- 24(22). Antennae with first flagellar segment equal to, or shorter than, the distance between the inner eye margins at the level of the posterior ocelli 25
- Antennae with first flagellar segment considerably greater than the distance between the inner eye margins at the level of the posterior ocelli
 *azteca* (p. 293)
- 25(24). Wings predominantly xanthochromatic 26
- Wings predominantly or wholly melanochromatic 33
- 26(25). Forewings with apices wholly dark; occipital carina, as such, not attaining the preular suture 27
- Forewings with apices whitish hyaline or at least considerably paler than exterior submarginal dark band, if present; occipital carina attaining the preular suture 31
- 27(26). Posterolateral extensions of transverse groove on second abdominal sternite present and deeply incised; hind tibiae with inner tibial spur considerably longer than outer tibial spur 28
- Posterolateral extensions of transverse groove on second abdominal sternite lacking or only faintly indicated; hind tibiae with inner and outer tibial spurs of approximately equal length
 *marginata* (p. 299)
- 28(27). Antennae wholly dark 29
- Antennae with at least the apical segment tipped with orange, frequently several or all flagellar segments orange.
 *mildei* (p. 288)
- 29(28). Posterior femora above glabrous or at most with a few scattered hairs; forewings with exterior marginal dark band broad, occupying at least one-half of the distance from the wing apex to the middle of the third transverse cubital vein 30
- Posterior femora above armed with erect and recumbent bristle-like hairs, most noticeably distally; wings with exterior marginal dark band narrow, occupying considerably less than one-half of the distance from the wing apex to the middle of the third transverse cubital vein *angustimarginata* (p. 291)
- 30(29). Wings bright fiery red
 *chrysothemis chrysothemis* (p. 312)
- Wings brownish yellow or fulvous red.
 *chrysothemis lucasii* (p. 313)
- 31(26). Mesopleural tubercle produced, elevated to form a blunt tooth; forewing with exterior submarginal dark band scarcely, if at all, evident 32
- Mesopleural tubercle not produced, scarcely evident, not forming a blunt elevated tooth; forewing with exterior submarginal dark band present, well defined, but paling marginally to almost whitish hyaline *thisbe* (p. 303)
- 32(31). Wings lemon yellow to yellowish brown
 *pallidolimbata pallidolimbata* (p. 307)
- Wings reddish brown to fiery red
 *pallidolimbata smithi* (p. 308)
- 33(25). Antennae wholly dark; forewings and hind wings with whitish hyaline apices
 *mexicana* (p. 308)
- Antennal flagellar segments orange; fore-



FIGS. 26-40. Ventral views of the right volsella of the Nearctic species of *Pepsis*.

wings and hind wings wholly melano-
chromatic, apices dark
. *saphirus* (p. 287)

***Pepsis formosa* (Say)**

Pompilus formosus SAY, 1823, West. Quart. Reporter, Cincinnati, vol. 2, p. 76 (female).

Large-sized species. Geographically ditypic and dichromatic. Wings with exterior marginal bands of forewing clearly whitish hyaline, narrow, restricted to outer third of area external to closed wing cells. Antennae generally black, sometimes with distal segment tipped with orange, most frequently in the male. Vestiture, excepting iridescent tomentum, rather sparse, confined principally to head, pronotum, thoracic pleurites, propodeum, coxae, and under surfaces and apex of abdomen; female with fore femora below clothed with long, black, bristle-like hairs.

MALE: Head, antennae 12-segmented in both sexes; antennal flagellar sensoria broad, band-like (fig. 4); first flagellar segment equal to, or shorter than, distance between eyes at level of posterior ocelli; anterior ocellus considerably larger than posterior ocelli; clypeal margin arcuately to angulately incised; distal segments of labial and maxillary palpi equal to, or shorter than, length of their respective adjacent segments; antenno-cellar groove complete, deeply impressed; occipital carina incomplete, terminating much before the preular suture. Thorax, pronotal shoulders not very prominent, transverse, rounded; hind margin of pronotum arcuate; mesopleural tubercles prominent, almost dentate; propodeum abruptly declivous behind; subspiracular tubercles prominent, nearly dentate; lateral propodeal teeth moderately tuberculate; inner spur of middle and hind tibiae less than one-half of the length of the respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (fig. 17) brownish black, elongately trapezoidal, somewhat attenuated posteriorly; apical margin emarginate or not, rounded on corners, thickly clothed on median surface with black or brownish black, bristle-like hairs which are characteristically very long and bent at tips. Genitalia as illustrated (fig. 32).

FEMALE: Similar to male, but mesopleural tubercles not nearly so prominent; propodeal

tubercles much more pronounced than those of male.

GEOGRAPHIC RANGE: Northern Mexico, including Lower California, northward into Kansas, and westward into Nevada and southeastern California (fig. 41).

A considerable portion of the literature on the Nearctic species of *Pepsis* has been reported under the name of *formosa*. Indeed, virtually every species now known to occur in the Nearctic area has at one time or another been recorded as this species. Almost immediately following its original description, confusion as to its identity arose, partly because of the destruction of the type specimen and partly because of the imperfect knowledge of the genus. In a separate paper the writer (1948, pp. 133-135) has discussed the various interpretations offered by such writers as Cresson (1867, p. 144), Lucas (1895, pp. 736-738), Cockerell (1898, p. 146), Banks (1921, p. 23), and Salman (MS, pp. 121-129) concerning the identity of *formosa* and has concluded that the Lucas interpretation is correct.

A study of the morphological characteristics of *formosa* and three other closely related species (*grossa* Fabricius, 1798, p. 245; *obliquerrugosa* Lucas, 1895, p. 576; and *pattoni* Banks, 1944, p. 181) has revealed no structural characters of diagnostic value to exist between them. The differences between these forms are primarily colorational and geographical in nature. In addition, this complex is unique among the members of the genus in that the male possesses but 12-segmented antennae. The genitalia, antennal sensoria, and subgenital plates of the males appear to be identical, or within the expected range of variation. The females possess in common an enlarged anterior ocellus, peculiar hair modifications on the anterior femora, and a similar development of the mesopleural tubercle. Three of these forms are dark winged, while the fourth, *formosa*, *sensu stricto*, is predominantly xanthochromatic. Of the melano-chromatic forms, *grossa* is, according to Banks (1944, pp. 181-182; 1946, p. 334), restricted to northern South America, *obliquerrugosa* is, by the same authority, restricted to the West Indies, and *pattoni* Banks (1944, pp. 181-182), to southwestern United States. Lucas (1895) recognized the similarities existing

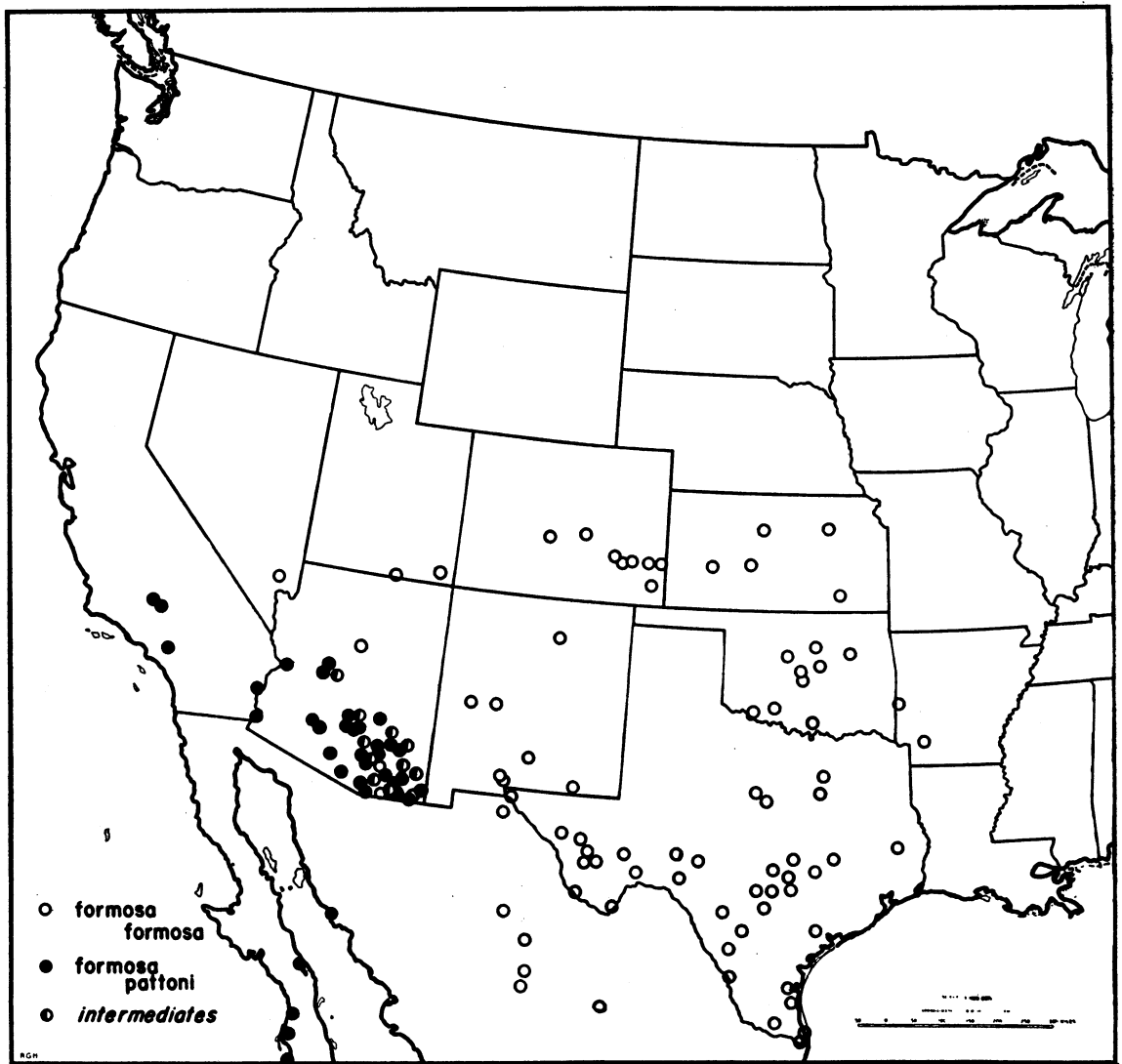


FIG. 41. Distribution of *Pepsis formosa* (Say).

between the genitalia of *grossa* and *formosa*, and for this reason only one genitalic figure was furnished for the two species. Despite the very close agreement in morphology, these species were placed by Lucas in two widely separated species groups, a consequence arising from the primary wing-color divisions utilized in his classification.

Salman (MS, pp. 134–139), having made a study of the complex, concluded that our southwestern United States form, formerly called *obliquerrugosa* by Fox (1898, p. 143) and by Banks (1921, p. 22), and the West Indian form, *obliquerrugosa* Lucas (1895, p. 576), were

synonymous with the northern South American *grossa* of Fabricius (1798, p. 245). Banks (1944, pp. 181–182) found these three dark-winged forms to be sufficiently different to warrant recognition as three distinct species, and for the form from southwestern United States he proposed the name *pattoni*. The present writer is of the opinion that these three forms and *formosa*, *sensu stricto*, are of equal evolutionary rank, most likely subspecies. The differences between them are subtle and very suggestive of a "Rassenkreis." However, owing to the incompleteness of our knowledge, particularly in the Central

American region, an assignment to any level would at the present time be purely arbitrary. Therefore, the writer has limited his studies to the two Nearctic representatives of the complex, *formosa* and *pattoni*.

If the distributional records of these two forms, which appear to differ only in the coloration of the wings, are plotted on the same map (fig. 41) it is quite evident that they are allopatric in distribution. A relatively long area of intergradation occurs roughly in the cordilleran area of eastern Arizona and presumably extends northward into southern Utah and southward into Mexico, though the incompleteness of the records for these areas gives no clue as to the extent of this contiguity. The intergradational nature of this zone is exhibited in the fact that the intermediate specimens display colorational characteristics attributable to both forms. Many specimens from this area possess the heavily infuscated wings of *pattoni*, but when viewed against a light background show very clearly the exterior submarginal dark band on the forewing, a characteristic of *formosa*, *sensu stricto*. In others, the intensity of the infuscation is intermediate between that of *pattoni* and *formosa*, *sensu stricto*, and in still others the infuscation may be darkest nearer the humeral and exterior submarginal bands, thus leaving only the central portion of the forewing similar to the condition found in *formosa*, *sensu stricto*. The intergradation between *pattoni* and *formosa*, *sensu stricto*, appears to be complete, and since no other differences are demonstrable they should be considered as subspecies.

Pepsis formosa formosa (Say)

Pompilus formosus SAY, 1823, West. Quart. Reporter, Cincinnati, vol. 2, p. 76 (female, inhabits Arkansas); 1828, Amer. Ent., pl. 42 (female). LECONTE, 1859, The complete writings of Thomas Say, vol. 1, pp. 91–92, 165, pl. 42, fig. 1 (*nec* LeConte's note, cf. *thisbe*, "within a hundred miles of Rocky Mountains, on banks of the Arkansas river"). BUCKLEY, 1862, Proc. Ent. Soc. Philadelphia, vol. 1, pp. 138–139 (Texas: Chapel Hill). LANCECUM, 1867, Amer. Nat., vol. 1, pp. 137–141 (Texas).

Pepsis formosa, CRESSON, 1867, Trans. Amer. Ent. Soc., vol. 1, p. 144 (in part) (female, Texas); *ibid.*, vol. 1, p. 378 (female, New Mexico). WALSH AND RILEY, 1869, Amer. Ent., vol. 1, pp. 111,

128–129, fig. 101. PEABODY, WALSH, AND RILEY, 1869, Amer. Ent., vol. 2, p. 52 (Missouri: Greenwood, Hematite, Eureka). RILEY, 1871, Second Ann. Rept. Insects Missouri, p. 106. CRESSON, 1872, Trans. Amer. Ent. Soc., vol. 4, p. 209 (male, female, Texas). RILEY, 1877, Trans. Acad. Sci. St. Louis, vol. 3, p. cclxix. MOCSÁRY, 1885, Termész. Füzt., vol. 9, p. 245 (in part). CRESSON, 1887, Trans. Amer. Ent. Soc., suppl. vol., p. 149. MCCOOK, 1890, American spiders, vol. 2, pp. 384–385, pl. 5, fig. 2 (Texas). RILEY, 1889, U. S. Dept. Agr. Insect Life, vol. 2, pp. 148–149 (New Mexico: Springer). LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 473–474, 729, 731, 733, 736–739, pl. 33, figs. 170, 230, 233 (male, female, Texas: Dallas; Mexico: Durango). FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141–142, 144 (male, female, *nec* Lower California record). ASHMEAD, 1890, Insects of New Jersey, p. 51; 1900, *ibid.*, p. 525, fig. (female). ENDERLEIN, 1901, Stettiner Ent. Zeitg., vol. 63, p. 146, fig. 3. HOWARD, 1902, The insect book, p. 136, pl. 7, fig. 21 (female). SNODGRASS, 1909, Proc. U. S. Natl. Mus., vol. 39, pl. 14, fig. 61, pl. 15, fig. 69. ASHMEAD, 1910, Insects of New Jersey, p. 673, fig. (female). KELLOGG, 1914, American insects, p. 501, fig. 701 (in part). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, pp. 257, 259 (male, female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 14, 108, 109, 114, 154, 170, pl. 1, figs. 23, 30b (male, female). MORRIS, 1933, Nat. Mag., vol. 21, p. 34. SMITH, 1943, Insects of Kansas, p. 409. HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 132–135 (male, female).

Pepsis rubra, MOCSÁRY, 1885, Termész. Füzt., vol. 9, p. 245 (in part, *nec* Drury, 1773, p. 75).

Pepsis nephele LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 732, 739 (female, Texas). FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141, 144 (female, Texas: Dallas). BANKS, 1912, Jour. New York Ent. Soc., vol. 19, p. 237 (female, *nec* male). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 258 (female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 155, 170 (female). BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (male, female). BROMLEY, 1933, Bull. Brooklyn Ent. Soc., vol. 28, p. 192 (Texas: College Station). BANKS, 1945, Bol. Ent. Venezolana, vol. 4, p. 81. (New synonymy.)

Pepsis formosa, var. *nephele*, COCKERELL, 1898, Proc. Davenport Acad. Nat. Sci., vol. 7, p. 146 (male, female, New Mexico: Las Cruces).

Pepsis pseudoformosa COCKERELL, 1898, Proc. Davenport Acad. Nat. Sci., vol. 7, p. 146 (male).

Wings predominantly yellowish brown, thickly clothed with yellow, orange, and red tomentose hairs.

MALES: With exterior submarginal dark band of forewing relatively broad, occupying a little more than one-half of the width of area external and adjacent to closed wing cells; sometimes exhibiting a double banding effect due to a central lessening in intensity of color in the band; occasionally may display infuscated areas in radial, third submarginal, and third discoidal cells; apices of hind wings frequently whitish hyaline, though sometimes completely infuscated with brown or black; exterior marginal band of hind wing, excluding apices, similar in extent and nature to that of forewing; humeral bands of both forewings and hind wings virtually obsolescent, confined to extreme wing bases.

FEMALES: With exterior submarginal dark band of forewing very broad, occupying all of area external to closed wing cells, except for narrow marginal whitish hyaline area, and may extend into closed cells as heavily infuscated spots, or coalesced regions, especially in radial, third submarginal, and third discoidal cells; exterior marginal dark band of hind wing somewhat narrower than that of forewing, more sharply delimited; apices of hind wings may or may not be whitish hyaline; humeral wing bands similar to those of male.

GEOGRAPHIC RANGE: Northwestern Mexico, northward into Kansas, and westward into eastern Arizona and southern Nevada (fig. 41).

A comparative geographic and morphologic study of *formosa*, *sensu stricto*, and *pattoni* has shown them to be subspecies. The evidence to support this treatment and the nature and extent of the intermediacy exhibited by specimens from the area of intergradation are discussed above.

In a separate study, the writer (1948, p. 134) found the exterior submarginal dark band of *formosa*, *sensu stricto*, to vary in width, from the relatively narrow type figured by Say (1828) to the condition found in the form described by Lucas (*supra. cit.*) as *nephele*. Lucas suggested that *nephele* might be only a variety of *formosa*, and subsequently Cockerell has accorded *nephele* that status. The findings of the present study indicate that this variation is independent of geography, and hence if desired *nephele* could be regarded as a variety.

Occasionally a double banding effect is evident in the exterior submarginal dark band of the forewing and is present in both sexes, but seems to be more commonly encountered in the male. This condition is apparently produced by a lessening in the intensity of coloration in the central portion of the band, particularly in specimens exhibiting the broad type of band. A tendency towards a darker

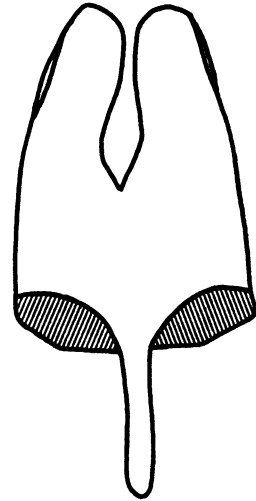


FIG. 42. Ventral view of an atypical subgenital plate of *Pepsis formosa* (Say).

infuscation of the areas immediately adjacent to the exterior submarginal dark band of the forewing, most frequently in the third submarginal cell and the third discoidal cell, was noted in certain specimens from the more eastern portions of the geographic range. However, since specimens from other areas occasionally display this type of variation, no taxonomic significance is attached.

A few specimens labeled from unspecified localities in New Mexico and Texas have the wings heavily infuscated as in *pattoni*. These specimens may represent the culmination of a melanistic trend evident in certain series originating from the same locality.

One male specimen from a series collected 30 miles north of Douglas, Cochise County, Arizona, on August 1, 1946, by Prof. H. A. Scullen of Oregon State College possesses a most unusually modified subgenital plate (fig. 42). It is somewhat asymmetrical, shorter, and much more deeply incised on its

apical margin than the normal subgenital plate (fig. 17) possessed by the species; however, since other structures, including the genitalia, are as in the normal type, no significance is attached to this most remarkable type of variation.

***Pepsis formosa pattoni* Banks, new status**

Pepsis ornata, CRESSON, 1875, Rept. Geogr. Geol. . . . Surv. west of 100th meridian, vol. 5 (Zool.), p. 713 (male, female, Nevada, Colorado, New Mexico, Arizona). FOX, 1893, Proc. California Acad. Sci., ser. 2, vol. 4, p. 9 (male, Lower California: San José del Cabo). (*Nec* Lepeletier, 1845, p. 486.)

Pepsis terminata, FOX, 1894, Proc. California Acad. Sci., ser. 2, vol. 4, p. 100 (female, Lower California: San José del Cabo, El Taste); 1895, *ibid.*, ser. 2, vol. 5, p. 265 (male, Lower California: San José del Cabo). (*Nec* Dahlbom, 1844, p. 120.)

Pepsis obliquerrugosa, FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141-143 (male, female, Mexico, Arizona). BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 22. (In part; *nec* Lucas, 1895, p. 576.)

Pepsis pattoni BANKS, 1944, Bull. Mus. Comp. Zool., Harvard Coll., vol. 94, pp. 181-182 (male, female, Arizona: Palmerlee, southern Arizona, Tucson, Ora, Fort Grant, Pinalena Mountains, Santa Catalina Mountains; California: mountains near Pomona). HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 124-126, 144-145, fig. 1 (male, female, California: Blythe, Tehachapi Pass).

Wings heavily infuscated throughout with dark brown, except for exterior marginal band of forewing and sometimes extreme apices of hind wings which are whitish hyaline; strongly violaceous in certain lights, reflecting rose violet; apices of hind wings may or may not be whitish hyaline.

GEOGRAPHIC RANGE: Western Mexico, including Lower California, northward into Arizona, and southeastern California (fig. 41).

This subspecies has been variously referred to as *ornata* by Cresson and Fox, as *terminata* by Fox, and as *obliquerrugosa* by Fox and Banks. As has been previously indicated, Banks (1944, pp. 181-182) has considered *pattoni* as specifically distinct from the West Indian species, *obliquerrugosa* Lucas (1895, p. 576), of similar structure and coloration, and has treated it as such.

A new status for *pattoni* is indicated by the similar structures shared with *formosa*, *sensu stricto*. As is mentioned elsewhere, these two forms are the only members of the Nearctic *Pepsis* fauna that possess but 12-segmented antennae in the male. Moreover, no significant differences could be found in such structures as the genitalia, the antennal sensoria, or the subgenital plates of the male, or in an examination of the composite characters of the female. Additionally, many specimens of both *pattoni* and *formosa*, *sensu stricto*, exhibit an orange-tipped apex to the last antennal flagellar segment, a characteristic most unusual for an otherwise "black antennal species."

In distribution, *pattoni* is allopatric with *formosa*, presenting an area of intergradation with that subspecies wherein a high percentage of intermediates exist. The nature of these intergrading types is discussed in the considerations of that subspecies.

The majority of the Lower California specimens before the writer were collected by A. E. Michelbacher and E. S. Ross at night by the use of artificial lights. This is the first evidence that suggests a nocturnal activity of the genus.

***Pepsis sapphirus* Palisot de Beauvois**

Pepsis ruficornis, CRESSON, 1865, Proc. Ent. Soc. Philadelphia, vol. 4, p. 134 (male, female, Cuba); 1867, Trans. Amer. Ent. Soc., vol. 1, p. 148 (male, female, Cuba). ASHMEAD, 1900, Trans. Ent. Soc. London, p. 309 (Puerto Rico). BANKS, 1928, Harvard Biol. Lab. and Bot. Garden in Cuba, vol. 1, pp. 3-5 (Cuba: Soledad; Bahamas; Haiti). DEWITZ, 1881, Berliner Ent. Zeitschr., vol. 25, p. 263 (female, Puerto Rico). GUNDLACH, 1886, Contribution à la entomologia Cubana, vol. 2, pt. 2, p. 123 (male, female, Cuba). WOLCOTT, 1936, Jour. Agr. Univ. Puerto Rico, vol. 2, p. 566 (Puerto Rico: Jayuya, Vega Baja). (*Nec* Fabricius, 1781, p. 450.)

Pepsis sapphirus PALISOT DE BEAUVOIS, 1806, Insectes recueillis en Afrique et en Amérique, p. 39, pl. 1, fig. 4 ("Saint Domingue").

Pepsis sapphirus, SMITH, 1855, Catalogue of hymenopterous insects in the . . . British Museum, pt. 3, p. 198. CRESSON, 1863, Proc. Ent. Soc. Philadelphia, vol. 1, p. 318; 1867, Trans. Amer. Ent. Soc., vol. 1, p. 149. BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 245 (male). BANKS, 1946, Bull. Mus. Comp. Zool., Harvard Coll., vol. 96, p. 316 (West

Indies). (*Lapsus* or emendation for *saphirus* Palisot de Beauvois, 1806, p. 39.)

Small- to medium-sized species. Wings heavily infuscated throughout with dark brown, thickly clothed with blue and green tomentose hairs; brilliantly violaceous in bright light; the above combination imparting a resplendent sapphire bluish sheen in freshly emerged specimens. Antennae bicolorous, with majority of flagellar segments bright orange; scape, pedicel, and sometimes basal flagellar segment black. Vestiture relatively sparse, confined principally to head, pronotum, thoracic pleurites, propodeum, ventral surfaces of coxae, and under surfaces and apex of abdomen; legs generally bare, though some specimens with a few scattered hairs on upper surfaces of femora.

MALE: Head, antennal flagellar sensoria basal and apical, consisting of two opposing isosceles triangles which sometimes fuse at their apices, thereby forming a constricted band (figs. 6, 7); first flagellar segment of antennae shorter than distance between eyes at level of posterior ocelli; anterior ocellus equal in diameter to posterior ocelli; clypeal margin angularly emarginate medially; distal segments of labial and maxillary palpi equal to, or shorter than, their respective adjacent segments; antenno-cellar groove complete, though scarcely impressed; occipital carina incomplete, terminating considerably before pre-gular suture. Thorax, pronotal shoulders not very conspicuous, transverse, rounded; hind margin of pronotum arcuate; mesopleural tubercles prominent, dentate; propodeum not abruptly declivous behind; subspiracular tubercles evident, moderately developed; lateral propodeal teeth tuberculate; inner spur of middle and hind tibiae much less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes present on fourth and fifth sternites; those on fourth sternite divisible into two tufts located laterally and composed of long, apically reflexed bristles; fifth sternite with a dense transverse row of short, erect, bristle-like hairs. Subgenital plate (fig. 16) black, flat, narrow, somewhat elongate, constricted near base, apical margin nearly truncate, clothed with a few short, erect, black hairs. Genitalia as illustrated (fig. 31).

FEMALE: Very similar to male, but the first flagellar segment of the antennae nearly equal in length to distance between eyes at level of posterior ocelli; lateral propodeal teeth are characteristically less tuberculate than those of the male.

GEOGRAPHIC RANGE: West Indies to southern Florida.

This West Indian species is known from the Nearctic area by a single female specimen collected at Cherokee, Florida. The specimen, which is in the collections of the University of Massachusetts, bears no indication of the date of capture or of the collector; however, as in *marginata*, another West Indian species of similar status, it seems quite probable that *saphirus* does occur in southern Florida.

Banks (1946, p. 316) is of the opinion that the West Indian species *saphirus* has been confused with *ruficornis*, a species described by Fabricius (1781, p. 450) from "America meridionalis," and subsequently reported by Cresson (1865, p. 134; 1867, p. 148), Lucas (1895, pp. 599, 601), and others from the West Indies. Banks (*loc. cit.*) indicates that the male of *saphirus* possesses secondary sexual characteristics "unlike anything I have seen, so far, from South America," and hence considers the West Indian form a separate species. Palisot de Beauvois (1806, p. 39; 1809, p. 94) reports both his new species, *saphirus*, from "Saint-Domingue" as well as the Fabrician *ruficornis*, though he does indicate that *saphirus* is questionably equivalent to *Pepsis ramicornis* [*sic*] Fabricius.

I have been unable to discover a *Pepsis ramicornis* described by Fabricius or any other author, and therefore it would appear that the orthography thus employed by Palisot de Beauvois is a *lapsus* for *ruficornis* Fabricius (1781, p. 450). If such is shown to be the case, then certainly considerable doubt exists as to the validity of *saphirus*. Notwithstanding, the colored figures of the two forms in question as furnished by Palisot de Beauvois are most assuredly different in colorational features, and therefore I have followed the conclusion of Banks in the identity of this West Indian species.

Pepsis mildei Stål

Pepsis mildei STÅL, 1857, Öfvers. K. Vetensk.-Akad. Förhandl., vol. 14, p. 64 (California).

LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 754, 769, 777-778 (male, California: San Diego). FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141, 142, 145 (male, female). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 260 (male). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 126, 130, 155, 171, pl. 1, fig. 26, pl. 2, fig. 55 (male). BANKS, 1919, Bull. Mus. Comp. Zool., Harvard Coll., vol. 63, p. 248 (California: Claremont, Pasadena, San Jose, San Luis Obispo); 1921, Ann. Ent. Soc. Amer., vol. 14, p. 22 (male, female). PASSMORE, 1933, Natl. Geogr. Mag., vol. 64, pp. 203, 205, 211. CLARK, 1937, Natl. Geogr. Mag., vol. 72, pp. 50, 55. HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 124-129, figs. 1, 2 (male, female, California: many records).

Pepsis marginata, CRESSON, 1872, Trans. Amer. Ent. Soc., vol. 4, p. 209 (Texas). PUTNAM, 1876, Proc. Davenport Acad. Nat. Sci., vol. 1, p. 194 (Utah: Spring Lake Villa). CRESSON, 1876, Proc. Davenport Acad. Nat. Sci., vol. 1, p. 208 (Utah: Spring Lake); 1887, Trans. Amer. Ent. Soc., suppl. vol. 1, p. 149. (*Nec* Palisot de Beauvois, 1809, p. 94.)

Pepsis formosa, LABOULBÈNE, 1895, Ann. Ent. Soc. France, vol. 64, pp. 179-190, fig. 1 (California). PASSMORE, 1936, Nat. Mag., vol. 27, pp. 155-159 (California); 1937, Illus. London News, vol. 190, pp. 404-405 (California). (*Nec* Say, 1823, p. 76.)

Pepsis hesperia PATTON, 1894, Proc. Ent. Soc. Washington, vol. 3, pp. 46-47 (male, California: Poway, San Diego County). FOX, 1894, Proc. California Acad. Sci., ser. 2, vol. 4, p. 101 (male, Lower California: El Taste).

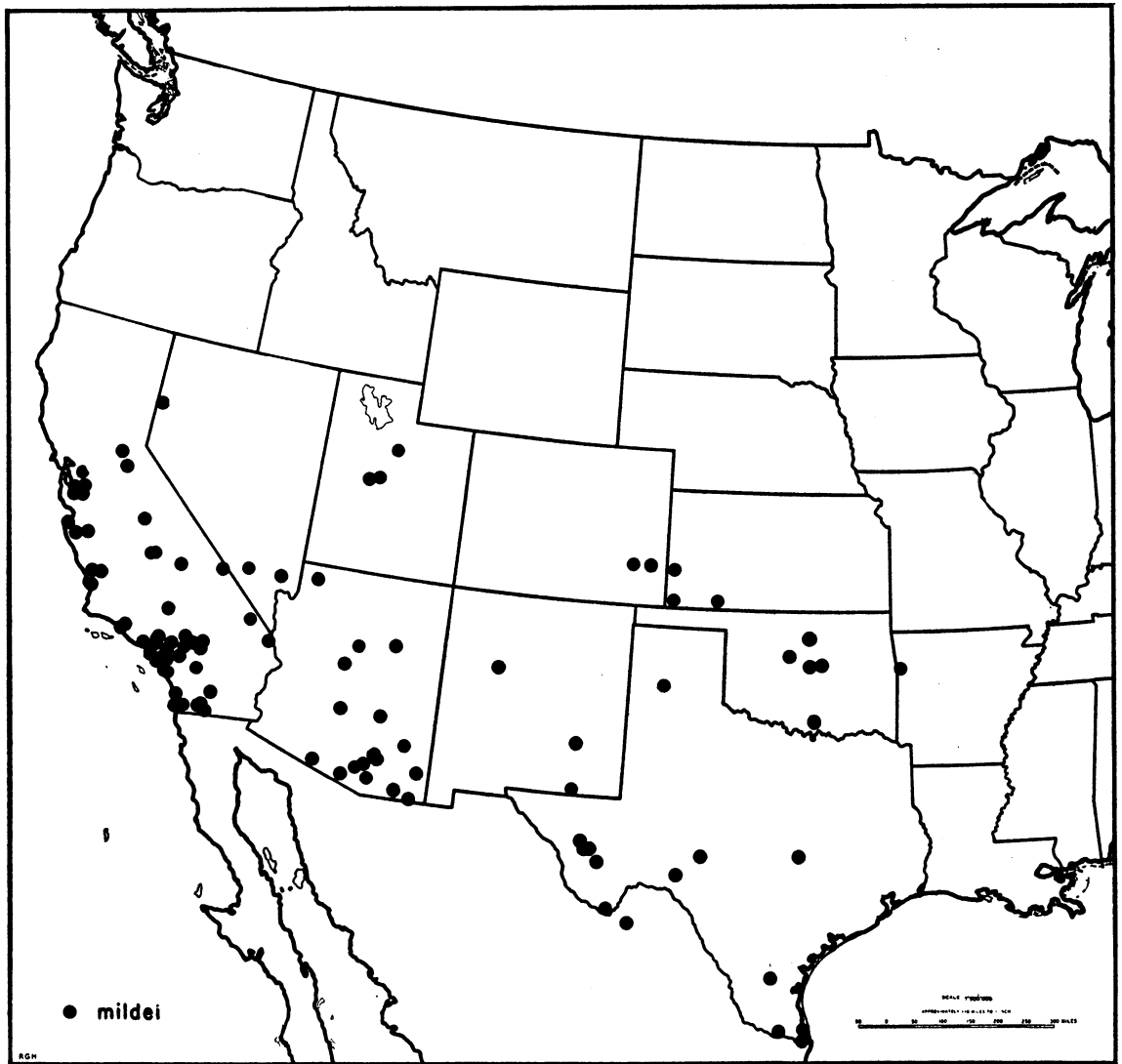
Pepsis boguei FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141, 142, 146-148, figs. 13, 14 (male, female, Texas; Colorado; "Oklahoma Territory"). VIERECK, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 232 (Arizona: Oak Creek Canyon, 6000 feet). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, pp. 261, 262 (male, female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 154, 171. BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (male, female). SMITH, 1943, Insects of Kansas, p. 409, fig. 457.

Medium- to large-sized species. Wings yellowish brown, covered with numerous yellow, orange, and brown tomentose hairs; exterior marginal and humeral bands dark brown, usually reflecting copper in bright light; marginal band of forewing extending from serial vein and apex posteriorly to axillary excision, but narrowing posteriorly, frequently darkest near its inner margin;

humeral band nearly twice, or else considerably more than twice, the greatest width of exterior marginal band; exterior marginal band of hind wing somewhat narrower than exterior marginal band of forewing, but broadens posteriorly and merges with humeral band which extends at least into one-third of the median cell. Males rarely with melanistic wings. Antennae bicolorous, bright orange and black (see discussion below for details). Vestiture, excepting iridescent tomentum, black or brownish black, relatively sparse, confined mostly to head, including clypeus, pronotum, thoracic pleurites, coxae, under surfaces and apex of abdomen; legs bare, or with a few scattered hairs on femora above.

MALE: Head, antennae with small, somewhat triangular, basal type of flagellar sensoria, but subject to variation (figs. 9, 10; also see discussion below); first flagellar segment shorter than distance between eyes at level of posterior ocelli; anterior ocellus approximately equal in diameter to posterior ocelli; clypeal margin broadly concave though somewhat angled medially; distal segments of labial and maxillary palpi equal to, or shorter than, length of their respective adjacent segments; antenno-cellar groove complete, distinct; occipital carina incomplete, terminating considerably before the pregenal suture. Thorax, pronotal shoulders prominent, rounded, scarcely protuberant; hind margin of pronotum arcuate; mesopleural tubercles prominent, dentate; propodeum not abruptly declivous behind; subspiracular tubercles evident; lateral propodeal teeth usually present, moderately tuberculate; inner spur of middle and hind tibiae less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes present on both fourth and fifth abdominal sternites; those on fourth sternite consisting of two obliquely arranged rows of long, black, apically curved bristles; fifth sternite bears posteriorly two short tufts of uncinat bristles. Subgenital plate (fig. 15) elongate, posterior edge nearly truncate, slightly turned downward; ventral surface clothed with numerous short, black hairs. Genitalia as illustrated (fig. 30).

FEMALE: Very similar to male in most respects; differences lie chiefly in the first flagellar segment which may be nearly equal to distance between eyes at level of posterior

FIG. 43. Distribution of *Pepsis mildei* Stål.

ocelli; exterior marginal dark bands and humeral bands may be somewhat more restricted in extent and hence frequently narrower than those of male.

GEOGRAPHIC RANGE: Northern Mexico, including Lower California, northward into Kansas and westward to the Pacific coast (fig. 43).

Mildei is one of our more common and widely distributed species. It is readily distinguishable from other species with xanthochromatic wings by the possession in the male of hair brushes on both the fourth and fifth

abdominal sternites, with those of the fourth consisting of two obliquely arranged rows of apically curved bristles. Additionally, the antennal flagellar sensoria are small, somewhat triangular, and markedly differentiated areas characteristically confined to the basal portion of the flagellar segments.

An interesting and somewhat unusual type of antennal sensorial variation was encountered in the study of specimens collected the same day and on the same patch of milkweed. Instead of having the sensorial areas confined to the basal portion of the flagellar

segment (fig. 9), certain specimens possessed an additional sensorial area near the apex of each segment (fig. 10). In specimens exhibiting this type of variation, the apical sensorial area varies from a small, scarcely discernible impression to a well-defined and highly differentiated region. Morphologically there appear to be no differences between the forms with the apical modification and those without, and since the characteristic is independent of geography, no taxonomic significance is attached.

The variation in coloration inherent in the antennae of *mildei* has been intimated in a previous paper by the writer (1948, pp. 127, 129). At that time it was remarked that none of the material seen from west of the Coast Range Mountains of California displayed any reduction in the number of orange-colored segments, despite the fact that in other portions of the geographic range the majority, and in certain examples all, of the flagellar segments are black or brownish black. Since that time the writer has studied in some detail a single population in the Coast Ranges and has found expressed therein every antennal colorational type known to occur in the species. The variation is quite apparently independent of the sex mechanism, for both sexes are equally affected. Nevertheless, there does appear to be a tendency towards a greater number of orange-colored flagellar segments in material originating from coastal California, but the significance is of somewhat dubious taxonomic value.

The genitalia and the secondary sexual characteristics of the male, most notably the hair brushes and the antennal sensorial areas, place this species closest to *angustumarginata*, a relationship also suggested by the similarities existing between the females of the two species.

Pepsis angustumarginata Viereck

Pepsis montezuma, SNOW, 1907, Trans. Kansas Acad. Sci., vol. 20, p. 132 (Arizona: Oak Creek, San Bernardino Ranch). (*Nec* Smith, 1855, p. 199.)

Pepsis angustumarginata VIERECK, 1908, Trans. Amer. Ent. Soc., vol. 33, p. 398 (female, Arizona: Oak Creek Canyon, 20 miles southwest of Flagstaff, Coconino County; Utah: Salt Lake City). BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, pp.

22, 23 (male, female, Arizona: Palmerlee, Dragon).

Pepsis sayi BANKS, 1926, Canadian Ent., vol. 58, pp. 202-203 (female, *nec* male; male=*thisbe*, *q.v.*, Arizona: Palmerlee).

Small- to medium-sized species. Wings predominantly yellowish brown, thickly clothed with yellow and orange tomentose hairs; exterior marginal band of forewing brown, narrow, usually occupying three-fourths or less of area external to closed wing cells, extends marginally from near apex of radial cell to or near axillary excision, considerably narrowed posteriorly; humeral band of forewing relatively broad, extends fully three-fourths of length of median cell; exterior marginal dark band of hind wing similar to that on forewing, but much narrower and somewhat more diffusely colored; humeral band of hind wing similar to that of forewing, though usually somewhat broader. Antennae unicolorous, black or brownish black. Vestiture, excepting iridescent tomentum, relatively dense, short, confined to head, thorax, coxae, and under surfaces and apex of abdomen; leg bare in male; in female, upper surfaces of femora with posteriorly directed, rather long, bristle-like hairs, most prominent on hind femora.

MALE: Head, antennae with small, basal, hemi-elliptical, flagellar sensoria (fig. 8) which may be subject to variation (see below); first flagellar segment plainly shorter than distance between eyes at level of posterior ocelli; clypeal margin arcuately to angularly incised; distal segment of labial palpus usually much shorter than length of adjacent segment; distal segment of maxillary palpus as long as, or longer than, adjacent segment; antennocellar groove complete, weakly impressed, best expressed immediately before anterior ocellus; occipital carina incomplete, terminating much before the preular suture. Thorax, pronotal shoulders poorly developed, considerably rounded; hind margin of pronotum arcuate; mesopleural tubercles prominent, nearly dentate; propodeum not at all abruptly declivous behind; subspiracular tubercles usually absent; lateral propodeal teeth poorly to moderately tuberculate, though sometimes absent; inner spur of middle and hind tibiae less than one-half of length of the respective basitarsi. Abdomen, ven-

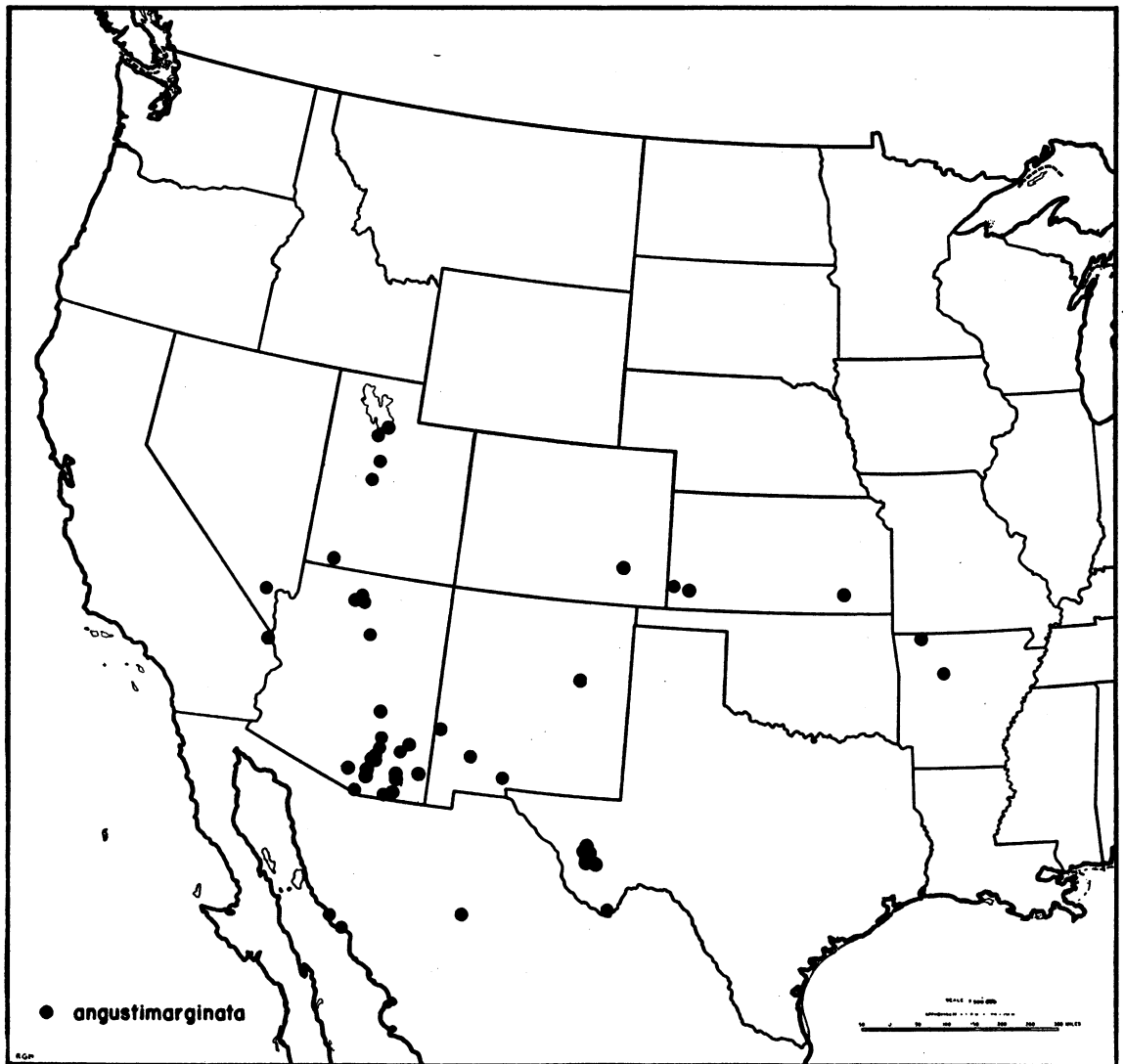


FIG. 44. Distribution of *Pepsis angustimarginata* Viereck.

tral hair brushes present on fourth sternite as two posteriorly directed, laterally placed tufts of long, apically reflexed bristles; fifth sternite with a few scattered hairs which are chiefly confined to lateral areas. Subgenital plate (fig. 11) flat, elongate, narrow, lateral margins arcuately convergent near middle, fully three times as long as broad; apical margin nearly truncate, rounded on corners; subgenital plate clothed on apical two-thirds with numerous short, erect, brown hairs. Genitalia as illustrated (fig. 26).

FEMALE: Similar to male, differs chiefly in that the exterior marginal dark bands of

wings are usually much narrower than those of the male; first flagellar segment is nearly as long as the distance between the eyes at level of posterior ocelli.

GEOGRAPHIC RANGE: Northern Mexico, northward into Kansas and westward into southeastern California (fig. 44).

Angustimarginata appears to be a widespread but rather uncommon species of *Pepsis*. In appearance and structure it is most closely allied to *basifusca* Lucas (1895, p. 798). The antennal flagellar sensorial areas of the male are small, hemi-elliptical, and confined to the basal portion of a flagellar seg-

ment (fig. 8), while those of *basifusca* are both basal and apical and may not always be hemi-elliptical, but may be elongate and approach somewhat the condition frequently exhibited in such species as *cerberus* and *elegans* (figs. 6, 7). While it would appear at the present writing that the antennal flagellar sensorial characters described above are segregable geographically, future investigations of the variability within a single population may demonstrate that the range of variation contains the intergrading types and hence is analogous to the condition existing in *mildei*.

Certain male specimens which have been determined as *basifusca* are somewhat more hirsute on the fifth abdominal sternite than the typical *angustimarginata*; however, even here the distinction is subtle. No differences were noted in the genitalia of the two forms, and the subgenital plates of *angustimarginata* and *basifusca* are quite similar. A critical examination of a number of provisionally determined female specimens of *basifusca* has failed to reveal characters of diagnostic value. Despite the striking similarities in appearance and structure it is the opinion of the writer that *angustimarginata* and *basifusca* should be considered as separate species, at least until such time as sufficient Mexican material becomes available and a careful reevaluation of the characters is made. The relationships of *angustimarginata* and *mildei* are discussed in the account of the latter.

Superficially *angustimarginata* females are quite similar to those of *chrysothemis lucasii*, but can be readily distinguished from the latter by the narrower exterior marginal band of the forewing and the presence of erect hairs on the upper surfaces of the middle, and more particularly the hind, femora.

Pepsis azteca Cameron

Pepsis azteca CAMERON, 1893, *Biologia Centrali-Americana*, Hymenoptera, vol. 2, pp. 215-216 (female, Mexico: Atoyac in Vera Cruz). LUCAS, 1895, *Berliner Ent. Zeitschr.*, vol. 39, pp. 754, 756-758, pl. 27, fig. 51, pl. 33, fig. 200 (male, female, Mexico; Costa Rica). BRÈTHES, 1914, *An. Mus. Nac. Hist. Nat. Buenos Aires*, vol. 26, p. 260 (male, female). LUCAS, 1919, *Arch. Naturgesch.*, div. A, vol. 83, no. 5, pp. 125, 126, 154, 170 (male, female). BANKS, 1925, *Bull. Mus. Comp. Zool.*, Harvard Coll., vol. 67, p. 337 (female, Panama: Barro Colorado).

Medium-sized species. Wings predominantly xanthochromatic, thickly clothed with yellow and orange tomentose hairs; exterior marginal dark band of forewing relatively broad, occupying three-fourths of area external to closed wing cells, extends from apex of radial cell, narrowing posteriorly, terminates at or near axillary excision; humeral band of forewing black, brilliantly violaceous in certain specimens when viewed in bright light, attains in width fully three-fourths or more of the length of median cell; exterior marginal dark band of hind wing somewhat narrower than that of forewing; humeral band of hind wing similar in extent and coloration to that of forewing. Antennal flagellar segments bright orange, pedicel and scape black. Vestiture, excepting iridescent tomentum, black, dense, especially on head including clypeus, pronotum, thoracic pleurites, propodeum, coxae, and under surfaces and apex of abdomen; legs bare, though sometimes with a few scattered femoral hairs.

MALE: Head, antennae with broad-band type of flagellar sensorial areas (fig. 4); first flagellar segment much shorter than distance between eyes at level of posterior ocelli; anterior ocellus much larger than posterior ocelli; clypeal margin weakly and angularly incised; distal segments of labial and maxillary palpi equal to, or shorter than, their respective adjacent segments; antennocellar groove complete, very narrow; occipital carina incomplete, terminating considerably before preular suture. Thorax, pronotal shoulders not very prominent, transverse, rounded; hind margin of pronotum arcuate; mesopleural tubercles very prominent; propodeum not abruptly declivous behind; subspiracular tubercles absent; lateral propodeal teeth present, moderately tuberculate; inner spur of middle and hind tibiae less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes present on central areas of both fourth and fifth sternites, undifferentiated, and which when viewed in profile are seen to slope posteriorly owing to the progressive decrease in length of hairs comprising the brush; individual hairs slightly reflexed at apex and directed caudad. Subgenital plate (fig. 12) nearly flat, spatulate, very strongly constricted near base; apical margin evenly rounded; clothed on ventral surface with short, brown or

black, posteriorly directed hairs. Genitalia as illustrated (fig. 27).

FEMALE: Agrees very closely with male in most respects, differs chiefly in that the first flagellar segment is nearly twice the length of the distance between the eyes at the level of the posterior ocelli.

GEOGRAPHIC RANGE: Panama northward into south central Texas.

Azteca can be recognized at once by the possession in the male of an undifferentiated hair brush which when viewed in profile slopes posteriorly owing to the progressive decrease in length of the hairs comprising the brush. The female is distinguished from our other Nearctic species of *Pepsis* by having the first flagellar segment of the antennae considerably longer than the distance between the eyes at the level of the posterior ocelli.

Five specimens of this species, previously unrecorded from the United States, were seen from Texas. Two females were collected by F. C. Bishopp on May 6, 1907, at Devil's River, Val Verde County, Texas, and are contained in the collections of the United States National Museum. Males collected at Austin, Travis County, Texas, on April 28, 1900, and at New Braunfels, Comal County, Texas, on June 27, 1917, are contained in the collections of the Museum of Comparative Zoölogy, Harvard College. Additional material was studied from the following Central American localities: Costa Rica, Honduras, Mexico, and Nicaragua.

Pepsis cerberus Lucas

Pepsis cerberus LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 780, 790-791, pl. 31, fig. 100, pl. 33, figs. 178, 225 (male, Mexico; Texas). FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 142, 145 (male, Texas). STRAND, 1910, Jahrb. Nassauischen Ver. Naturk., vol. 63, p. 15 (male, Texas: San Antonio). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 263 (male). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 136-139, 154, 171 (male). BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (male).

Pepsis inermis FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141, 146 (female, Texas). STRAND, 1910, Jahrb. Nassauischen Ver. Naturk., vol. 63, p. 16 (female, Texas: San Antonio). BANKS, 1912, Jour. New York Ent. Soc., vol. 19, p. 237 (female). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 265 (female).

LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 149, 155, 171 (female). BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (female).

Small- to medium-sized species. Wings predominantly xanthochromatic, thickly clothed with golden, yellow, and bright orange tomentose hairs; male with exterior marginal and humeral bands dark brown, nearly black; exterior marginal band of forewing broad, occupying the entire area external to closed wing cells and frequently extending in as far as base of third submarginal cell; humeral band very broad, extending inward the length of the median cell; exterior marginal band of hind wing as broad as, or sometimes broader than, that of forewing, broadly coalescing with the very broad humeral band, the two virtually obliterating yellowish brown coloration or else restricting it to the central area of wing. Female with exterior marginal band of forewings and hind wings dark brown, sharply delimited from paler wing coloration, occupying fully three-fourths of area external to closed wing cells; humeral bands much narrower than those of male, confined to basal third or less of median cell. Antennae unicolorous, black or brownish black. Vestiture, excepting iridescent tomentum, very sparse, confined principally to head, thorax, and under surfaces and apex of abdomen.

MALE: Head, antennal flagellar segments with basal and apical sensorial areas consisting of two opposing isosceles triangles (fig. 6) which sometimes fuse at their apices, forming a constricted band (fig. 7); first flagellar segment shorter than distance between eyes at level of posterior ocelli; anterior ocellus larger than posterior ocelli; clypeal margin arcuately incised medially; distal segments of labial and maxillary palpi usually much shorter than their respective adjacent segments; antennocellar groove complete, finely impressed; occipital carina incomplete, terminating much before the preular suture. Thorax, pronotal shoulders poorly developed, transverse, rounded; hind margin of pronotum arcuate; mesopleural tubercles prominent, dentate; propodeum not at all abruptly declivous behind; subspiracular tubercles virtually absent; lateral propodeal teeth poorly developed or absent; inner spur of middle and hind tibiae less than one-half of length of the respective basitarsi. Abdomen, ven-

tral hair brushes present on fourth sternite as two obliquely arranged rows of posteriorly directed bristles, the outer bristles of which are considerably longer than the inner; the brush when viewed from above presents a hemispherical outline on anterior margin; fifth sternite glabrous, or almost so, shiny medially, scarcely if at all pubescent. Subgenital plate (fig. 13) short, flat, apical portion expanded; basal portion usually narrowed, frequently much narrower than width of apical margin; sometimes subgenital plate is parallel sided, with apical margin variable, sometimes nearly hemispherical in outline, sometimes almost truncate, and more rarely slightly emarginate at apex. Genitalia as illustrated (fig. 28).

FEMALE: Similar in appearance to male; differs chiefly in having the inner and outer spurs of middle and hind tibiae uncinat; also differs in that the posterior tibiae on entire upper surface are armed with very long, apically curved bristles which are directed posteriorly.

GEOGRAPHIC RANGE: Northwestern Mexico, including Lower California, northward into Kansas and Arizona (fig. 45).

Cerberus is very closely related to *elegans*, but differs in the genitalia of the male (figs. 28, 29) and in the armature of the female tibiae, most noticeably the posterior ones. The antennae of *cerberus* are dark brown or black, while those of *elegans* are orange or reddish orange. The wings of *cerberus* are xanthochromatic and are margined exteriorly with a rather broad, dark band, while in *elegans* the wings are wholly melanochromatic and present a violaceous aspect owing to the entire coverage of the superior wing surfaces with minute, iridescent, tomentose hairs. In almost all other respects they are so similar as to suggest that their divarication has been relatively recent. The distributional patterns when plotted (fig. 45) suggest a sub-specific relationship. Moreover, there is evidence to suggest that hybridization occurs in the area of overlapping distribution, for when this area is scrutinized in the light of the local *Pepsis* fauna, a third "species," *novitia* Banks (1921, p. 21), is found and appears to occur nowhere else. *Novitia* was originally described from a single male specimen, which is nearly identical in appearance to *cerberus* both in colorational respects and

in morphology, excepting the antennae which are orange or reddish orange. In this exception it is similar to *elegans*. The genitalia are intermediate between those of *cerberus* and of *elegans*, as is also the subgenital plate. Additional specimens of "*novitia*" have been studied, and the female possesses the *cerberus* type of wing pattern and coloration and the antennal color and tibial armature of *elegans*.

It appears to this writer that *cerberus* and *elegans* are sufficiently isolated reproductively to prevent a collapse of the genic mechanism which is apparently maintaining them as distinct populations. Only the "*novitia*" type of hybrid has been found, and until such time as an intergrading series is demonstrated it would appear best to regard *cerberus* and *elegans* as having attained the evolutionary level of "species." Admittedly the apparent lack of intergrading types may be due to the collector and not the genetic mechanism. Even so, when the level of speciation of *cerberus-elegans* is contrasted with that of such complexes as *formosa-pattoni*, *chrysothemis-lucasii*, and *pallidolimbata-smithi*, it is quite evident that on morphological grounds the point of divarication is considerably older for *cerberus-elegans*. In these above-cited complexes, which are treated elsewhere in the present paper, the differences reside chiefly in the distributions and secondarily in morphology. Their morphologic expressions are confined to colorational differences and are not yet manifest as structural modifications of the genitalia or of those associated with the tibial characteristics present in the two species *cerberus* and *elegans*.

Occasionally males of *cerberus* with melanic wings appear in collections from Arizona, and these specimens superficially resemble *Pepsis mexicana*, but can be separated immediately from that species by the presence of the semi-circular row of bristles, the hair brush, on the fourth abdominal sternite. One male from Lower California has the wings entirely melanic except for a small central patch of dark brownish orange on the forewing, and in this respect it is very similar to the West Indian species *Pepsis sanguigutta*.

***Pepsis elegans* Lepeletier**

?*Pepsis luteicornis*, PALISOT DE BEAUVOIS, 1806, Insectes recueillis en Afrique et en Amérique, p. 39, pl. 1, fig. 4 (female, South Carolina). CRESSON,

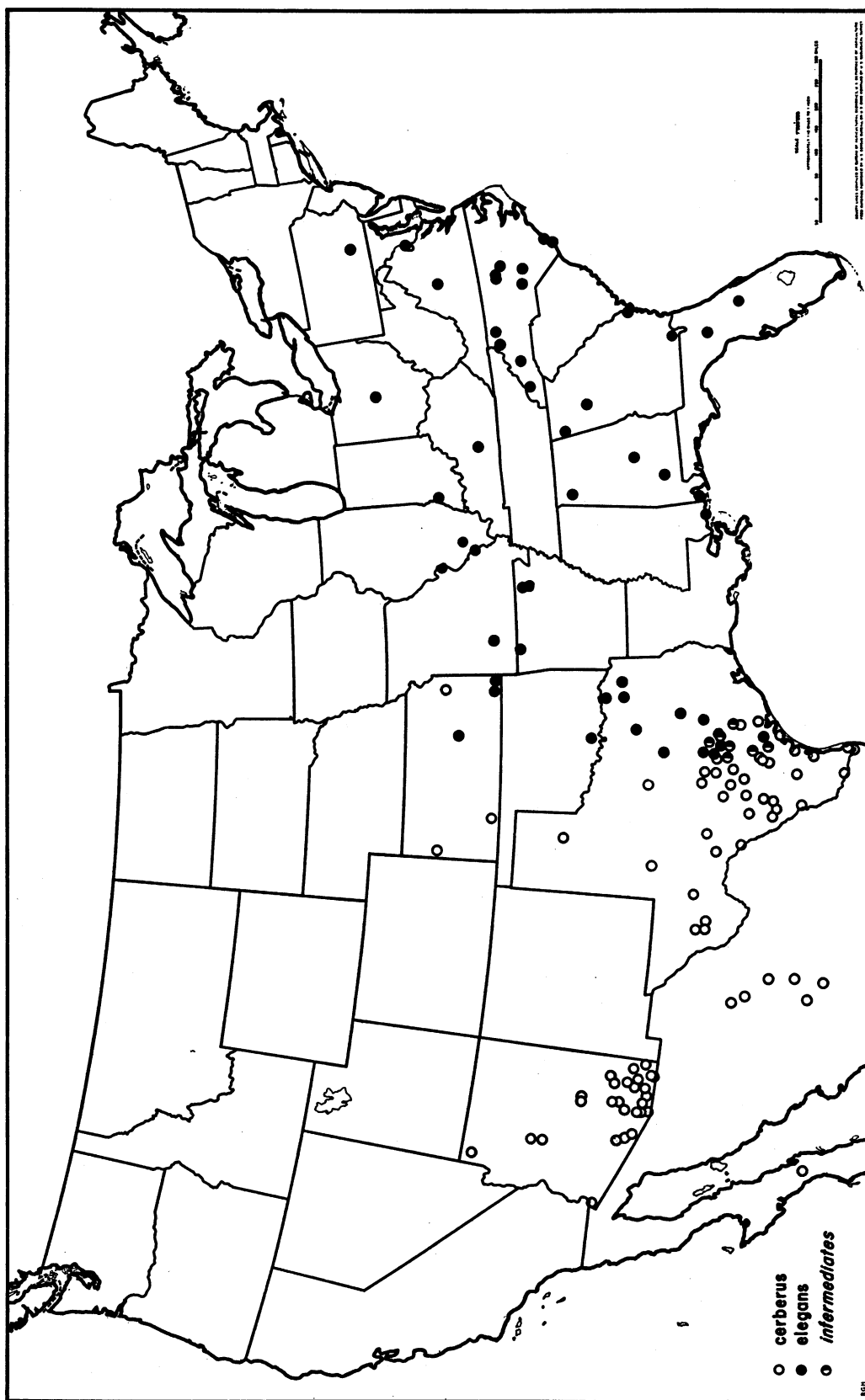


FIG. 45. Distribution of *Pepsis cerberus* Lucas and *Pepsis elegans* Lepeletier.

1863, Proc. Ent. Soc. Philadelphia, vol. 1, p. 318; 1867, Trans. Amer. Ent. Soc., vol. 1, p. 145; 1887, *ibid.*, suppl. vol., p. 149. (*Nec* Fabricius, 1805, p. 214.)

Pepsis elegans LEPELETIER, 1845, Histoire naturelle des insectes, vol. 3, p. 489 (male, "Pensylvanie"). SMITH, 1855, Catalogue of hymenopterous insects in the . . . British Museum, pt. 3, p. 201 (male, female, Pennsylvania; Georgia). CRESSON, 1863, Proc. Ent. Soc. Philadelphia, vol. 1, p. 318; 1867, Trans. Amer. Ent. Soc., vol. 1, pp. 144-145 (male, female); 1887, *ibid.*, suppl. vol., p. 149. LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 605, 814-815. FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141-143 (male, female, Georgia; Florida; Texas). ASHMEAD, 1890, Insects of New Jersey, p. 51; 1900, *op. cit.*, p. 525. VIERECK, 1909, Ent. News, vol. 20, p. 329 (Pennsylvania: Harrisburg). ASHMEAD, 1910, Insects of New Jersey, p. 673. BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 245. LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 164, 165. BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 22. SALMAN, 1929, Trans. Amer. Ent. Soc., vol. 55, pp. 119-153, pls. 6-9. BRIMLEY, 1936, Jour. Elisha Mitchell Sci. Soc., vol. 52, p. 118 (male, female, North Carolina: Raleigh, Wilmington, Durham, Southport, Bryson City, Homestead, Lyons, Blowing Rock, Asheville, Wilkes County, Fayetteville); 1938, Insects of North Carolina, p. 432 (North Carolina: state wide). HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 126, 143-144, fig. 1 (male, female; California record is a misidentification, cf. *mildei*).

Pepsis dubitata CRESSON, 1867, Trans. Amer. Ent. Soc., vol. 1, p. 144 (male, female, Georgia); 1872, *ibid.*, vol. 4, p. 209 (male, female, Texas); 1887, *ibid.*, suppl. vol., p. 149. LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 605, 814. BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, pp. 245, 246 (male, female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, p. 154. RAU AND RAU, 1918, Wasp studies afield, pp. 67-71 (female, Missouri: vicinity of St. Louis).

Salix magnus, HOWARD, 1902, The insect book, pl. 7, fig. 22 (female). (*Nec* Cresson, 1867, p. 111.)

Small- to medium-sized species. Wings melanochromatic, heavily infuscated throughout with dark brown; violaceous in appearance; thickly clothed with minute, brown, brownish black, and black tomentose hairs. Antennae bicolorous, flagellar segments bright orange, scape, pedicel, and sometimes base of first flagellar segment black. Vestiture, excepting iridescent tomentum, sparse,

short, best expressed on head, pronotum, thoracic pleurites, propodeum, ventral surfaces of coxae, and under surfaces and apex of abdomen; legs bare.

MALE: Head, antennal flagellar segments with basal and apical sensorial areas consisting of two opposing isosceles triangles (fig. 6) which sometimes fuse at their apices, forming a constricted band (fig. 7); first antennal flagellar segment shorter than distance between eyes at level of posterior ocelli; anterior ocellus plainly larger than posterior ocelli; clypeal margin angulately to arcuately emarginate medially; distal segments of labial and maxillary palpi usually much shorter than their respective adjacent segments; antennocellar groove complete, though finely impressed; occipital carina incomplete, terminating considerably before the pregular suture. Thorax, pronotal shoulders poorly developed, rounded; hind margin of pronotum arcuate; mesopleural tubercles prominent, dentate; propodeum not at all abruptly declivous behind; subspiracular tubercles virtually absent; lateral propodeal teeth poorly developed or absent; inner spur of middle and hind tibiae less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes present on fourth sternite as two obliquely arranged rows of posteriorly directed bristles, the outer bristles of which are considerably longer than inner ones; the brush when viewed from above presents a hemispherical outline on anterior margin; fifth sternite glabrous, shiny, scarcely if at all pubescent. Subgenital plate (fig. 14) short, flat, apical portion generally expanded, imparting a hemispherical outline to apical margin, though sometimes apex may be nearly truncate; basal portion of subgenital plate narrowed, much less as a rule than apical portion; however, sometimes nearly parallel sided, with apical margin almost truncate or slightly emarginate. Genitalia as illustrated (fig. 29).

FEMALE: Very similar to male, differs most noticeably by having the inner and outer spurs of middle and hind tibiae uncinately; also differs from male in having the upper posterior surface of hind tibiae with bristles that are considerably longer than the serrate spines and are curved and directed posteriorly.

GEOGRAPHIC RANGE: Eastern United States from eastern Texas to Missouri, thence eastward to the Atlantic coast (fig. 45).

This species is the only truly eastern member of the genus found in the United States. It was described from Pennsylvania by Lepeletier and has been regarded by some workers, most notably Lucas (1895, p. 605), as questionably equivalent to his *auranticornis*, a species that he described as new from Mexico and Brazil. Lucas (1895, pp. 607–608) believed that *elegans* and a species described by Cresson (1867, p. 144) as *dubitata* from Georgia were reported from areas in which the genus *Pepsis* did not occur. It is quite obvious, however, that the genus does occur east of the Mississippi River and as far north as southern Pennsylvania (fig. 2) despite Lucas' comments to the contrary. That author was also disturbed over Lepeletier's remarks concerning the ferruginous margin on the posterior portions of each abdominal sternite, even though Smith (1855, p. 201) had demonstrated that the "red margin of the abdominal segments of the male is attributable to the iridescence of the pile, and is most observable in sunlight," a condition that is observable in many specimens of both sexes. Indeed, even worn specimens display this characteristic, as do those in which the tomentum is removed mechanically, and for this reason it is evident that *dubitata*, as Cresson (1867, p. 144) suspected, is identical to *elegans*.

Whether or not *auranticornis* is synonymous with *elegans* must await further study of the Mexican and Central American *Pepsis* faunas. It appears that *elegans* is represented in some material collected by the David Rockefeller Mexican Expedition of the American Museum of Natural History, but until such time as a more critical study of this and other material from the Mexican and Central American areas can be made it would be, perhaps, better to regard the species distributed as indicated in the accompanying map (fig. 45).

Elegans was erroneously reported from California in a recent paper by the present writer (1948) under the impression that the specimen was truly a representative of the eastern species. A subsequent examination of the specimen in question has clearly shown

that it is a melanistic form of *mildei*—indeed, the only such case known for that species.

The relationship existing between *elegans* and its western counterpart, *cerberus*, is very close and is discussed in the treatment of the latter species.

Pepsis venusta Smith

Pepsis venusta SMITH, 1855, Catalogue of the hymenopterous insects in the . . . British Museum, pt. 3, p. 196 (male, Brazil: Tapajos). Fox, 1897, Proc. Acad. Nat. Sci. Philadelphia, vol. 49, p. 282 (Brazil: Chapada, Corumbá, Mararu, Santarem). MocsÁRY, 1885, Termész. Füsz., vol. 9, pp. 247–248 (male, Mexico: Presidio; Brazil: Obidos). CAMERON, 1893, Biologia Centrali-Americana, Hymenoptera, vol. 2, p. 221 (male, Mexico: Presidio, Rio Papagaio, Xucumanatlan, Santiago, Iscuintla, Rinconada, Valladolid, Temax; Brazil). LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 551, 555–557, pl. 23, fig. 11, pl. 30, fig. 75, pl. 31, fig. 96, pl. 32, fig. 116 (male, Brazil; Mexico: Presidio). BANKS, 1912, Jour. New York Ent. Soc., vol. 19, p. 237 (male, Arizona: Palmerlee). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 243 (male). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 33–34, 156, 168 (male, Honduras: Minas Gerais [*sic*]). BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 22 (male). CAMPOS, 1929, Rev. Colegio Nac. Vicente Rocafuerte, no. 38–39, p. 13 (Ecuador: El Salado, Chimbo).

Pepsis (*Stenopepsis*) *venusta*, BANKS, 1946, Bull. Mus. Comp. Zool., Harvard Coll., vol. 96, pp. 313, 364, 375, 402 (male, female, Brazil: Corumbá, Urucum).

Small- to medium-sized species. Wings predominantly melanochromatic, heavily infuscated throughout with dark brown, except for very broad, whitish hyaline, exterior marginal band on forewing, wings strongly violaceous in bright light; exterior marginal band of forewing occupying entire area external to closed wing cells and extending basally into radial and third submarginal cells frequently as far as their bases. Antennae bicolorous, basal flagellar segments black, apical two or three segments bright orange. Vestiture, excepting iridescent tomentum, relatively sparse, confined chiefly to head, pronotum, thoracic pleurites, propodeum, and coxae; legs bare.

MALE: Head, antennae with flagellar sensorial areas small, hemi-elliptical, depressed, markedly differentiated from surrounding in-

tegument, confined to basal portion of the flagellar segments (fig. 8); first flagellar segment shorter than distance between eyes at level of posterior ocelli; anterior ocellus somewhat larger than posterior ocelli; clypeal margin subangulately incised; distal segments of labial and maxillary palpi equal to, or shorter than, their respective adjacent segments; antennocellar groove complete, deeply impressed; occipital carina incomplete, terminating much before the pregenal suture. Thorax, pronotal shoulders very prominent, tuberculate; hind margin or pronotum subangulate; mesopleural tubercles usually very prominent and dentate; propodeum not abruptly declivous behind; subspiracular tubercles evident, but poorly developed; lateral propodeal teeth absent; inner spur of middle and hind tibiae much less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (fig. 21) black, shiny, scarcely hirsute, strongly curved downward apically, lateral margins sinuate, divergent towards apex, apical margin slightly, but distinctly, emarginate; basal portion of plate elevated in form of a low, sharply carinate, medio-longitudinal ridge which runs posteriorly and terminates about middle of plate; on either side of this carinate ridge extends a low carinate ridge which originates near basal third of the subgenital plate. Genitalia as illustrated (fig. 36).

FEMALE: Unknown.

GEOGRAPHIC RANGE: Brazil northward into southern Arizona.

The occurrence in the United States of this widely distributed species is based upon the record of Banks (1912, p. 237) wherein he reports a specimen from Palmerlee, Arizona. An examination of the specimen, which is contained in the collections of the Museum of Comparative Zoölogy, Harvard College, shows it to be a male bearing the label "Palmerlee, Ariz., Aug." No collector is indicated. Males of *venusta* have been seen from various localities in Brazil, Costa Rica, Honduras, Guatemala, and Mexico; however, no additional specimens have been seen from the United States.

Insofar as I have been able to ascertain, the female remains undescribed, even though Banks (1946, p. 313) in discussing the females of the *pretiosa* group states that "the

females of at least two [*pretiosa* group], *egregia* and *venusta*, are much like the males, but *venusta* is very hairy." His remarks on pages 364, 375, and 402 are confined to the male.

Venusta is a very distinctive species, being separated at once from our Nearctic species by the very broad, whitish hyaline area of the forewing.

Pepsis marginata Palisot de Beauvois

Guêpe-Ichneumon, RÉAUMUR, 1742, Mémoires pour servir à l'histoire des insectes, vol. 6, pl. 28, fig. 1.

Pepsis marginata PALISOT DE BEAUVOIS, 1809, Insectes recueillis en Afrique et en Amérique, p. 94, pl. 2, figs. 2, 3 (male, female, "Saint Domingue"). LEPELETIER, 1845, Histoire naturelle des insectes, hyménoptères, vol. 3, p. 470 (male, female). SMITH, 1855, Catalogue of the hymenopterous insects in the . . . British Museum, pt. 3, p. 199. CRESSON, 1863, Proc. Ent. Soc. Philadelphia, vol. 1, p. 318; 1865, *ibid.*, vol. 4, p. 133 (male, female, Cuba); 1867, Trans. Amer. Ent. Soc., vol. 1, p. 145 (male, female, Cuba). MOCsÁRY, 1885, Termész. Füzet., vol. 9, p. 264, (male, female). GUNDLACH, 1886, Contribution à la entomologia Cubana, vol. 2, pt. 2, pp. 121-123 (Cuba). RADOSZKOWSKI, 1888, Bull. Soc. Nat. Moscou, vol. 2, p. 488, pl. 15, fig. 39 (male). LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 779, 781, 793-797, pl. 28, fig. 70, pl. 30, figs. 77-79, pl. 32, figs. 142, 147, pl. 33, figs. 173, 187 (male, female). SCHULZ, 1903, Sitz.-Ber. Akad. Wiss. München, vol. 33, pp. 468-469 (male, female, Puerto Rico; Haiti). BRÈTHES, 1914, An. Mus. Nat. Hist. Nat. Buenos Aires, vol. 26, pp. 263, 265 (male, female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 14, 134, 136, 137, 139, 155, 161, 166, 168, pl. 1, figs. 41, 48 (male, female). BANKS, 1928, Harvard Biol. Lab. Bot. Garden in Cuba, vol. 1, pp. 3, 4 (male, female). PETRUNKEVITCH, 1926, Jour. Exp. Zool., vol. 45, pp. 367-393, pls. 1, 2 (Puerto Rico). WOLCOTT, 1936, Jour. Agr. Univ. Puerto Rico, vol. 20, p. 565 (Puerto Rico: Luquillo, Rio Piedras, Mayaguez).

Pepsis heros DAHLBOM, 1844, Hymenoptera Europaea, vol. 1, p. 122 (female, Santo Domingo); 1845, *op. cit.*, p. 465 (female).

Wings predominantly xanthochromatic, thickly clothed with orange and red tomentose hairs; exterior marginal band of forewing brown or black, broad, occupying entire area external to closed wing cells, extends from apex of radial cell to axillary excision; exterior marginal band of hind wing similar, some-

what narrower; humeral bands relatively narrow, one-third of, or less than one-third of, length of median cell. Antennae black or brownish black. Vestiture, excepting iridescent tomentum, relatively dense, especially on head, thoracic pleurites, and coxae; legs bare.

MALE: Head, antennae with broad-band type of flagellar sensorial areas (fig. 4); first flagellar segment of antennae equal to, or shorter than, distance between eyes at level of posterior ocelli; anterior ocellus somewhat larger than posterior ocelli; clypeal margin angulately emarginate medially; distal segment of labial palpus equal to, or shorter than, length of adjacent segment; distal segment of maxillary palpus equal to, or longer than, length of adjacent segment; antenno-cellar groove present, deeply impressed, except immediately before anterior ocellus; occipital carina incomplete, terminating considerably before preangular suture. Thorax, pronotal shoulders prominent, but rounded; hind margin of pronotum arcuate; mesopleural tubercles prominent, well developed; propodeum almost abruptly declivous behind; subspiracular tubercles present; lateral propodeal teeth moderately tuberculate; inner and outer spurs of middle and hind tibiae of approximately equal length, but are shorter than one-half of length of their respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (fig. 20) black, shiny, strongly arched downward, apical margin rounded on corners, slightly emarginate medially; lateral margins sinuate; basal portion of subgenital plate bears medially a high, thin, sharp, longitudinal carinate process which abruptly drops off posteriorly and continues towards apex of subgenital plate as a low carinate ridge; length of high basal process on upper surface variable, sometimes almost an acute tooth, other times a rather long, carinate ridge. Genitalia as illustrated (fig. 35).

FEMALE: Very similar to male in almost all respects; differs principally in the greater development of propodeal features; posterolateral extensions of transverse groove on second abdominal sternite lacking or only faintly indicated; hind tibial spurs as in the male.

GEOGRAPHIC RANGE: West Indies to southern Florida.

The occurrence of this West Indian species within the Nearctic area rests upon two female specimens contained in the collections of the University of Massachusetts. One specimen is labeled from Cherokee, Florida, and the other from Chokoloske, Florida; each lacks any additional information. Nevertheless, it is quite likely that the species does occur in southern Florida, since a number of specimens have been seen from the northern island groups of the West Indies.

Several authors (Ashmead, 1894, p. 47; Cresson, 1876, p. 208; 1872, p. 209; 1887, p. 149; Patton, 1894, p. 47; Putnam, 1876, p. 194; and Snow, 1907, p. 132) have recorded *marginata* from various localities in the southwestern United States. Since many, if not all, of the specimens upon which these records are based have been seen and have been found to be misidentified, it seems certain that *marginata* does not occur in the southwestern United States. Cresson (1872, p. 209) described from Texas a variety of *marginata* as *sericata*, remarking that it was covered with dense, "silvery-sericeous pile." It is almost impossible to believe that *sericata* could be related to *marginata*, and since none of our known Nearctic or Central American species of *Pepsis* possesses this type of vestiture, *sericata* may well not even belong to the genus.

The present writer is in full agreement with Salman (MS, p. 116) in considering *domingensis* Lepeletier (1845, p. 477) a separate and distinct species, even though both Lucas (1895, 1919) and Schulz (1903) are of the opinion that the species in question are synonymous. As is evidenced by the studies of Banks (1928, p. 3) on the West Indian species of *Pepsis*, *domingensis* and *marginata* are unequivocally distinct, though closely related.

Pepsis arizonica Banks

Pepsis domingensis, SNOW, 1907, Trans. Kansas Acad. Sci., vol. 20, p. 132 (Arizona: Oak Creek). (*Nec* Lepeletier, 1845, p. 477.)

Pepsis arizonica BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, pp. 21-23 (male, Arizona: Huachuca Mountains).

Pepsis hirsuta SALMAN, 1933, Pan-Pacific Ent., vol. 9, pp. 9-10 (female, Arizona: southern Arizona, Yavapai County). (New synonymy.)

Medium- to large-sized species. Wings predominantly xanthochromatic, clothed dense-

ly with minute, orange, tomentose hairs; exterior marginal and humeral bands black, sharply delimited from adjacent wing coloration; exterior marginal band of forewing broad, occupying almost entire area external to closed wing cells, narrowing posteriorly, extending from distal apex of radial cell to nearly axillary excision; humeral band of forewing broad, attaining one-third of length of submedian cell, its very dark coloration attributable to black tomentose hairs; exterior marginal band of hind wing somewhat narrower than that on forewing, gradually narrowing posteriorly to its union with humeral band; occasional female specimens exhibit a double banding effect of the exterior marginal band of forewing due to a central lessening of infuscation. Antennae black or brownish black, in some apically tipped with orange, or with apex of each flagellar segment partially ringed with orange. Vestiture, excepting iridescent tomentum, black, dense, especially on head, including clypeus, pronotum, propodeum, thoracic pleurites, coxae, abdominal sternites, fore femora of male, and all femora of female.

MALE: Head, antennae with broad-band type of flagellar sensorial areas (fig. 4); first flagellar segment of antennae shorter than distance between eyes at level of posterior ocelli; anterior ocellus distinctly larger than posterior ocelli; clypeal margin slightly, but evenly, incised; distal segments of labial and maxillary palpi much shorter than their respective adjacent segments; antenno-cellular groove evident, complete, but weakly impressed; occipital carina incomplete, terminating much before the pre-gular suture. Thorax, pronotal shoulders not prominent, rounded, posterior margin angulate; mesopleural tubercles scarcely evident; propodeum abruptly declivous behind; subspiracular tubercles absent; lateral propodeal teeth well developed, tuberculate; middle and hind tibiae each with indications of anterolateral and posterolateral longitudinal grooves; inner spur of middle and hind tibiae approximately one-half of length of the respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (fig. 19) black, subrectangular, lateral margins convergently arcuate, apex angulately incised, rounded on posterolateral corners; basal portion bears

an elevated, flat-topped, triangular process, whose apex in some specimens extends distally in the form of a low, median carina which terminates near middle of plate; lateral margins turned upward to form a distinctly rounded, dorsally flattened, low, glabrous, and impunctate ridge; area between the lateral ridges and from distal side of triangular process to near apex of subgenital plate depressed, strongly sculptured with foveate and setigerous punctures from which numerous short, erect, black hairs arise; extreme lateral margins provided with short, posteriorly directed, black hairs. Genitalia as illustrated (fig. 34).

FEMALE: Similar to male in most respects; differs chiefly in being more hirsute, particularly on thorax, legs, and abdomen, in having the anterolateral and posterolateral longitudinal grooves of middle and hind tibiae deeply incised, and in having the inner spur of middle and hind tibiae more than one-half of length of the respective basitarsi; subspiracular tubercles and lateral propodeal teeth are present, but poorly developed.

GEOGRAPHIC RANGE: North central Mexico, northward into western Texas, southern Arizona, and southeastern California.

The species *arizonica*, described by Banks from a single male specimen collected in the Huachuca Mountains of Arizona, and *hirsuta*, described by Salman from two female specimens, one from southern Arizona and the other from Yavapai County, Arizona, are doubtless sexes of one species, *arizonica*, and are so treated here. Morphologically *arizonica* is a very distinctive species not closely related to any of our known Nearctic species. In the female the body is very densely haired, as are also the femora. The tibia of the middle and hind legs bear on their anterolateral and posterolateral surfaces a deeply incised longitudinal groove. The inner tibial spur of the hind leg is over one-half of the length of the basitarsus, and the distal flagellar segments of the antennae are flattened on their inner surfaces. The abdomen is quite decidedly compressed dorsoventrally. The male is very similar in appearance and gross morphology. However, the development of the structures as enumerated for the female is less pronounced, especially with respect to the anterolateral and posterolateral

longitudinal grooves on the middle and hind tibiae. The inner tibial spur is slightly less than one-half of the length of the basitarsus in some specimens. The shape of the subgenital plate appears to relate it to *aquila* and *pyramus*, but the peculiar tibial modifications place it more closely with the South American species *cassandra*.

SPECIMENS EXAMINED: Twenty-six, from the following localities: Arizona: southern, one female, August, 1902 (F. H. Snow); Oak Creek Canyon, one male, two females, July (F. H. Snow), one male, two females, August (F. H. Snow); Huachuca Mountains, one female, August 13, 1903 (Osler). California: Needles, one male, August 1, 1925. Mexico: Nombre de Dios, Durango, one male, two females, August 13, 1947 (C. D. Michener); Palos Colorados, Durango, one male, August 5, 1947 (H. T. Spieth); 20 miles southwest of Camargo, Chihuahua, one female, August 13, 1947 (M. A. Cazier). Texas: Davis Mountains, one female, August 29, 1947 (J. N. Knull); Limpia Canyon, 5000 feet, Davis Mountains, two females, July 14–22, 1948 (H. E. Evans); 6 to 10 miles west of Fort Davis, 5000 feet, nine males, July 23, 1948 (H. E. Evans).

Snow (1907, p. 132) reported a West Indian species, *domingensis*, from Oak Creek, Arizona, but an examination of the material on which this record is based clearly demonstrates that the determination is erroneous. Several female specimens before the writer are identified as "*Pepsis marginata*," also a chiefly West Indian species and to which *arizonica* bears a superficial resemblance. It is quite likely, therefore, that certain of the reports recording *marginata* from the southwestern United States are actually referable to *arizonica*.

Pepsis aquila Lucas

Pepsis aquila LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 779, 797, pl. 30, fig. 76, pl. 32, fig. 135 (male, Mexico). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 263 (male). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 136, 137, 153, 171 (male, Mexico).

Medium-sized species. Wings predominantly xanthochromatic, thickly clothed with yellow and orange tomentose hairs; exterior

marginal band of forewing dark brown, almost black, darkest near apex of radial cell, occupying three-fourths or more of area external to closed wing cells, broadest at wing apex, gradually narrowing posteriorly and terminating before axillary excision (one specimen displays a narrow, almost whitish hyaline band on inner margin of the exterior marginal dark band on its posterior half); exterior marginal band of hind wing considerably narrower than that of forewing, broadest and darkest at apex, becoming very narrow and pale posteriorly; humeral bands of forewing virtually non-existent, those of hind wing similar, except for the dark infuscated anal wing area. Antennae brownish black or black. Vestiture, excepting iridescent tomentum, sparse and short, confined to head, thorax, and coxae.

MALE: Head, antennae with broad-band type of flagellar sensorial areas (fig. 4); first flagellar segment of antennae shorter than distance between eyes at level of posterior ocelli; anterior ocellus considerably larger than posterior ocelli; clypeal margin subangulately to arcuately incised medially; distal segment of labial palpus equal to, or shorter than, length of adjacent segment; distal segment of maxillary palpus much longer than length of adjacent segment; antennocellar groove incomplete, not attaining anterior ocellus; occipital carina complete, attaining preular suture. Thorax, pronotal shoulders scarcely developed, flattened, and rounded; hind margins of pronotum arcuate; mesopleural tubercles very prominent, dentate, nearly carinate above; propodeum not abruptly declivous behind; subspiracular tubercles absent; lateral teeth of propodeum present, tuberculate; inner spur of middle and hind tibiae less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (fig. 18) short, nearly parallel sided, apical margin broadly hemispherical in outline; semicircular apical portion of subgenital plate depressed, especially in central area, and accentuated by elevation of lateral margins near bases of semicircular area; basal portion of subgenital plate decidedly elevated medially into a weakly triangular process from which posteriorly extends a low, mediolongitudinal carina which terminates abruptly near middle

of plate. Genitalia as illustrated (fig. 33).

FEMALE: Unknown.

GEOGRAPHIC RANGE: North central Mexico, northward into southern Arizona and New Mexico.

Aquila was described from a single male specimen collected in "Mexiko" and has remained until recently virtually unknown. In 1947, C. D. Michener, serving as a member of the David Rockefeller Mexican Expedition of the American Museum of Natural History, secured a male at Nombre de Dios at 5900 feet, Durango, on August 13. Howard E. Evans in 1948 collected four males in Bear Canyon, Santa Catalina Mountains of Arizona, between August 4 and 5 at an elevation of 7000 feet. The Snow Collection of the University of Kansas contains a male collected by F. H. Snow at an unspecified locality in New Mexico.

Aquila is easily distinguished from all our known Nearctic species of *Pepsis* by the distinctive shape of the subgenital plate.

Pepsis thisbe Lucas

Pepsis formosa, LECONTE, 1859, The complete writings of Thomas Say, vol. 1, p. 92 (*nec* Say, LeConte's note: California: San Diego). CRESSON, 1867, Trans. Amer. Ent. Soc., vol. 1, pp. 144, 378 (female, California; New Mexico; Texas); 1872, Trans. Amer. Ent. Soc., vol. 4, p. 209 (Texas). FOX, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141, 142 (male, female, Lower California). COCKERELL, 1898, Proc. Davenport Acad. Nat. Sci., vol. 7, p. 146 (female, New Mexico: Mesilla Valley); 1916, Canadian Ent., vol. 48, p. 55 (Coronado Islands). ROHWER, 1917, Proc. U. S. Natl. Mus., vol. 53, p. 239 (male, female, California: Calaveras County). BANKS, 1919, Bull. Mus. Comp. Zool., Harvard Coll., vol. 63, p. 248 (male, female, California: San Emigdio Cañon); 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (male, female, in part, *nec* Say, 1823, p. 76).

Pepsis coerulea, CRESSON, 1875, Rept. Geogr. Geol. Surv. west of 100th meridian, vol. 5 (Zool.), p. 713 (male, female, Nevada). PATTON, 1879, Bull. U. S. Geol. Surv., vol. 5, p. 351 (Kansas). (*Nec* Linnaeus, 1758, p. 571.)

Pepsis rubra, CAMERON, 1893, Biologia Centrali-Americana, Hymenoptera, vol. 2, pp. 218-219, pl. 12, fig. 7 (male, female, Mexico, in part, *nec* Drury, 1773, p. 75).

Pepsis thisbe LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 732, 733, 737, 744, 745, pl. 26, fig. 44, pl. 33, fig. 195 (male, female, Mexico: Cuernavaca, Durango). BRÈTHES, 1914, An. Mus.

Nac. Hist. Nat. Buenos Aires, vol. 26, pp. 258, 259 (male, female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 108, 110-111, 170, pl. 1, fig. 29, pl. 2, fig. 48 (male, female). HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 124, 126, 129-136, figs. 1, 2 (male, female, California: many records).

Pepsis pallidolimbata, BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (male, *nec* female, *nec* Lucas, 1895, p. 745).

Pepsis cinnabarina, BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (male, *nec* female, *nec* Lucas, 1895, p. 804).

Pepsis sayi BANKS, 1926, Canadian Ent., vol. 58, pp. 202-203 (male, *nec* female which is *angustimarginata*).

Pepsis chrysothemis, COCKERELL, 1898, Proc. Davenport Acad. Nat. Sci., vol. 7, p. 146 (male, in part, *nec* Lucas, 1895, p. 739; New Mexico: Mesilla Valley). MCKENZIE, 1933, Pan-Pacific Ent., vol. 9, p. 159 (California, Twentynine Palms). (*Nec* Lucas, 1895, p. 739.)

Pepsis sherillae HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 124, 126, 146-147 (female, California: 8 miles west of Needles, San Bernardino County; Texas: Terlingua).

Medium-sized species. Wings predominantly xanthochromatic, thickly clothed with minute, yellow, orange, and red tomentose hairs; exterior marginal band of forewing whitish hyaline, usually infuscated with black, narrow, broadest at wing apex, occupying about one-half of the width of area external to closed wing cells, narrowing posteriorly and disappearing near inner wing angle; exterior submarginal dark band narrow, variable in width, usually one-half, or less, of the width of area external to closed wing cells, extending posteriorly adjacent to closed wing cells from anterior wing edge to or near axillary excision; occasionally this band may be almost absent; humeral band of forewing blackish brown, narrow, usually one-fourth of length of median cell or may be virtually absent; whitish hyaline character of exterior marginal border of hind wing less distinct than that of forewing, narrower; exterior submarginal dark band of hind wing less intense, begins at radial vein, progresses posteriorly and marginally, ultimately broadening and joining humeral band; humeral band of hind wing similar in nature and extent to that of forewing. Antennae black or brownish black. Vestiture, excepting iridescent tomentum, brown or black, fine, short,

restricted principally to head, pronotum, thoracic pleurites, propodeum, and coxae; legs bare, or at most with a few scattered hairs.

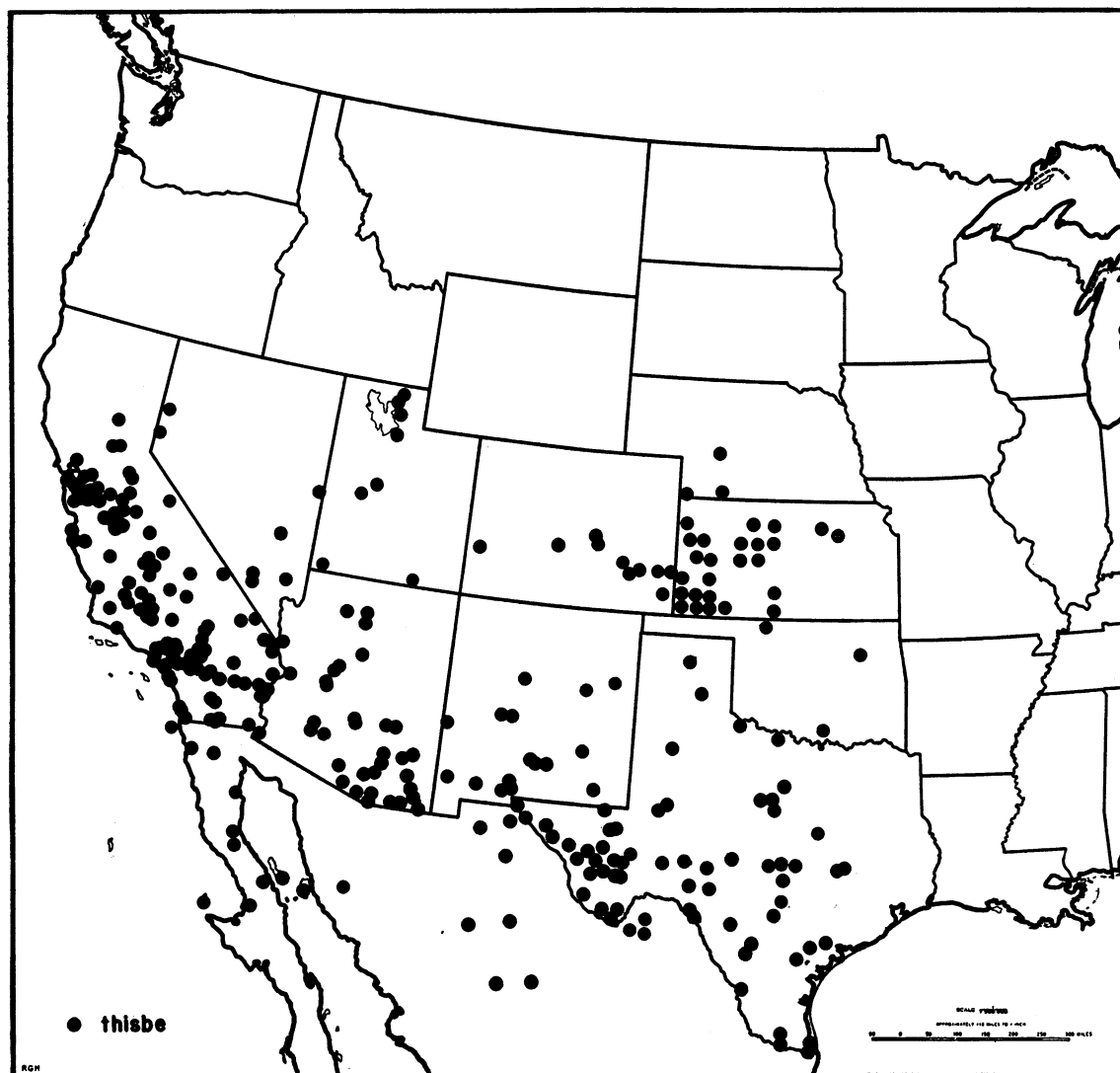
MALE: Head, antennae with broad-band type of flagellar sensorial areas (fig. 4); first flagellar segment of antennae shorter than distance between eyes at level of posterior ocelli; anterior ocellus slightly larger than posterior ocelli; clypeal margin weakly angulate medially; distal segments of labial and maxillary palpi frequently as long as, or longer than, their respective adjacent segments; antenno-cellar groove complete, distinct; occipital carina complete, attaining the pre-gular suture. Thorax, pronotal shoulders not very prominent, rounded; hind margin of pronotum arcuate; mesopleural tubercles evident, but very poorly developed; propodeum not abruptly declivous behind; subspiracular tubercles absent; lateral propodeal teeth usually evident and moderately tuberculate; inner tibial spur of middle and hind legs much less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (figs. 3, 25) convex, short, scarcely longer than wide, black or brownish black, clothed with rather fine, short, brown or brownish black pubescence except for area between apical and subapical transverse carinae which is sparsely, if at all, clothed; lateral margins convergently arcuate; apical margin abruptly curved downward, carinate, obtusely angled, sometimes slightly rounded off, clothed densely with fine, erect, short, brownish pubescence on posterior surface; a subapical carina extends laterad on either side of a distinct but blunt subapical median tooth (this carina is bent posteriorly about midway on either side of blunt tooth, again turns anteriorly about the middle, and ends abruptly near the lateral margin of the plate; in some specimens the lateral median portion of the carina is missing); area delimited by apical and subapical transverse carinae is hollowed out and shiny. Genitalia as illustrated (fig. 40).

FEMALE: Agrees quite closely with male, but exterior submarginal dark bands of forewings are usually darker and more intense; pronotum is devoid of hairs, or very nearly so; mesopleural tubercles less evident than those of male, almost obsolete.

GEOGRAPHIC RANGE: Northern Mexico, including Lower California, northward into southern Nebraska, thence westward to the Pacific coast (fig. 46).

Thisbe is perhaps our most common and widespread species of western North America and may ultimately be shown to be the most abundant member of the genus in the Nearctic area. The writer (1948, pp. 133-135) has attempted to unravel the mystery that has cloaked the identity of this species since it was described by Lucas. Most frequently it has been confused with *formosa* of Say (1823, p. 76), a species that has a similar distribution and that it superficially resembles. Cameron (1893) has figured the female of *thisbe* as *rubra*, having confounded it with this West Indian species. Fox (1893, 1894a, 1895) has recorded this species from Lower California under the name of *rubra*, and it is quite apparent from his remarks (1894a, p. 101) that he had at least one other species, *chrysothemis*, included in his series which exhibited "considerable variation," an opinion that has been substantiated by a study of the series in question. Snow (1907, p. 132) has recorded *thisbe*, in part, as *formosa*, *marginata*, and *montezuma*, as is evidenced by an examination of the specimens on which his determinations rest. The *Pepsis coerulea* of Cresson (1875, p. 713) and Patton (1879, p. 351) have been examined and are referable to this species, as are those records of *formosa* enumerated in the synonymical bibliography above.

There is but little doubt that the species recently described by the present writer (1948, pp. 146-147) as *sherillae* represents nothing more than a melanistic form of *thisbe*. Aside from the melanic condition of the wings, a comparative study clearly shows it to be morphologically indistinguishable. Its distribution is contained wholly within that of *thisbe*, is geographically non-segregable, and since it reappears discontinuously throughout the geographic range of *thisbe* it may be regarded, if desirable, as a variety of that species. The melanic condition appears to be confined to the male, but the possibility that female specimens exhibit this condition must be considered in the determination of the normally melanochromatic species *mexicana*, since a melanistic *thisbe* female would

FIG. 46. Distribution of *Pepsis thisbe* Lucas.

be so similar in appearance to *mexicana* that a misidentification could result. Therefore, if a particular female specimen, tentatively identified as *mexicana*, is suspected of being in reality a melanic specimen of *thisbe*, an examination of the occipital carina will indicate its affinities with one or the other species. Thus, in *thisbe* the occipital carina attains the preular suture, while in *mexicana* the carina ends considerably before the preular suture.

Thisbe appears to be most closely related to *chrysothemis* and *pallidolimbata*. There are ample differences in the males of these species, but in worn female specimens determina-

tion is sometimes quite difficult. The mesopleural tubercles in females of *thisbe* are evident but are much more poorly developed than the distinctly dentate type found in the afore-mentioned species.

Pepsis pallidolimbata Lucas

Pepsis pallidolimbata LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 733, 745-747, pl. 32, figs. 162, 164 (female, "Nordwest Amerika"). HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 126, 140-143, fig. 1 (male, female, California).

Small- to medium-sized species. Geographically ditypic. Wings predominantly xantho-

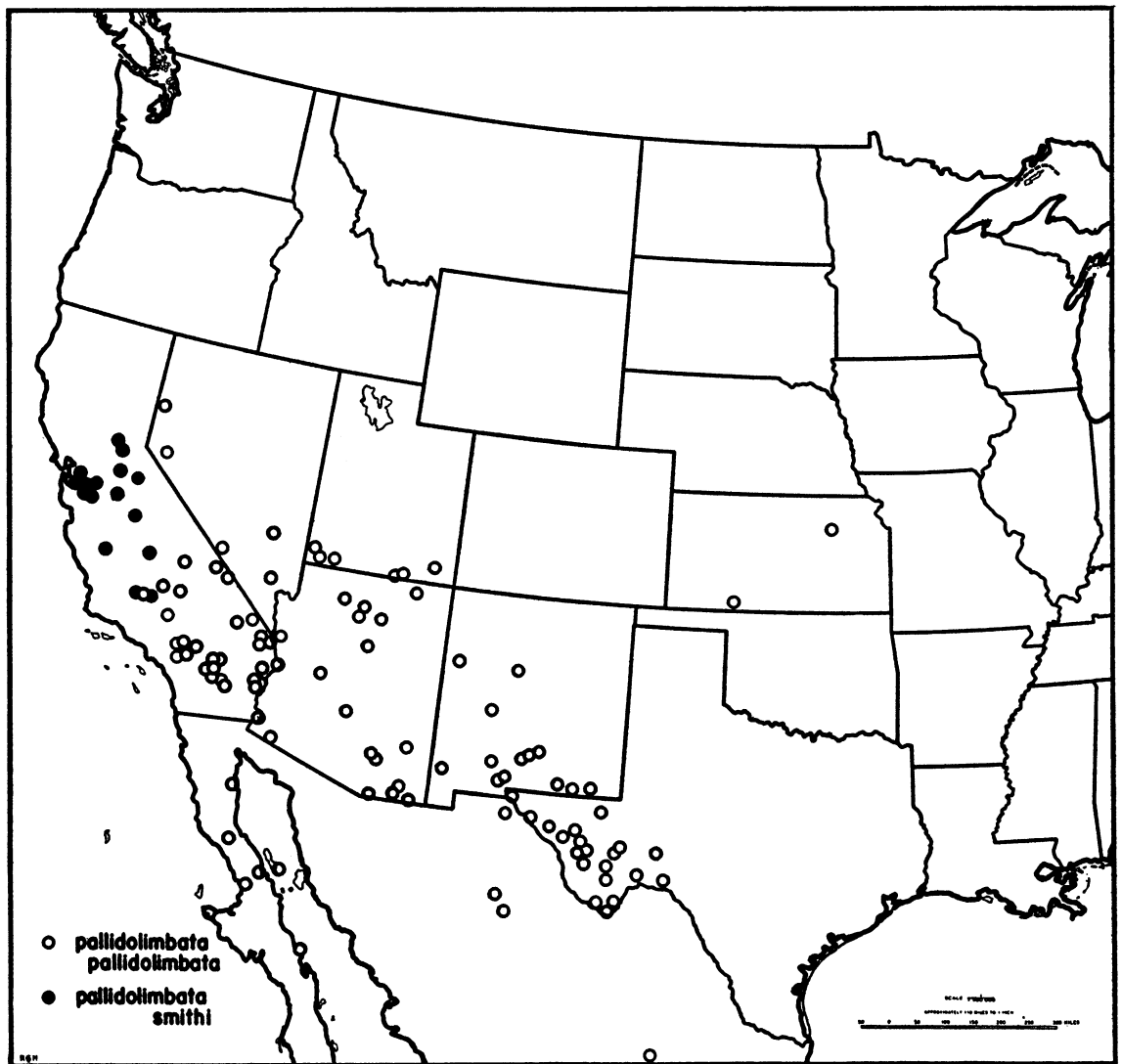


FIG. 47. Distribution of *Pepsis pallidolimbata* Lucas.

chromatic; exterior marginal wing band of forewing and extreme apex of hind wing narrowly whitish hyaline; humeral band of forewing and hind wing brown or blackish brown, broad, extending fully one-third of length of median cell in forewing and nearly three-fourths of length of median cell in hind wing. Antennae black or brownish black. Vestiture, excepting iridescent tomentum, brown or black, sparse, short, erect, confined chiefly to head, including clypeus, pronotum, thoracic pleurites, propodeum, coxae, and under surfaces and apex of abdomen; legs bare.

MALE: Head, antennae with broad-band

type of flagellar sensorial areas (fig. 4); first flagellar segment of antennae shorter than distance between eyes at level of posterior ocelli; anterior ocellus slightly larger than posterior ocelli; clypeal margin usually angulately incised; distal segment of labial palpus equal to, or shorter than, length of adjacent segment; distal segment of maxillary palpus much longer than the adjacent segment; antenno-cellar groove complete, attaining, or very nearly so, the preular suture. Thorax, pronotal shoulders moderately developed, rounded; hind margin of pronotum subangulate; mesopleural tubercles usually very

prominent, dentate; propodeum not abruptly declivous behind; subspiracular tubercles generally absent, if present, then very poorly developed; lateral propodeal teeth evident, weakly tuberculate; inner spur of middle and hind tibiae considerably less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (fig. 24) trapezoidal, brownish black, lateral margins slightly sinuate; apical margin bent downward to form a sharp, angulate, transverse carina with lateral portions sometimes thickened, slightly elevated, almost dentate, medial surface concavely depressed; posterior surface of this carina clothed with numerous short, erect, brownish, pubescent hairs; subapical transverse carina erect, sharp, slightly arcuate, nearly as long as apical carina; area delimited by apical and subapical transverse carinae concavely excavated, glabrous, smooth and shiny; area anterior to subapical transverse carina convexly produced, somewhat flattened medially, delimited laterally by a low, thickened ridge, clothed with erect, brownish pubescence. Genitalia as illustrated (fig. 39).

FEMALE: Very similar to male; pronotum usually devoid of hairs; lateral propodeal teeth distinctly dentate; first flagellar segment equal to, or shorter than, distance between eyes at level of posterior ocelli.

GEOGRAPHIC RANGE: Northern Mexico, including Lower California, northward into western Texas, New Mexico, and Utah, thence westward into southeastern California and northward to the foothills adjacent to the San Joaquin Valley of California (fig. 47).

Pallidolimbata is one of the more easily recognized species of the Nearctic *Pepsis* fauna. Its affinities with *chrysothemis* and more particularly with *thisbe* are suggested by similarities inherent in the genitalia, antennal sensorial areas, and subgenital plates of the males, and in the nature and extent of the occipital carinae of the females.

The species is divisible into two subspecies, which in comparison with the other Nearctic subspecies pairs, *chrysothemis-lucasii* and *formosa-pattoni*, appear to be the more recently derived unit. The incipency of the divarication is suggested by the small degree of morphologic differentiation and the nature of the distribution of the species. Signifi-

cantly, the morphologic divergence is expressed only in the relative intensities of the wing and body colorations and in the differential magnitudes of body size. Geographically, *pallidolimbata* is essentially xerophilic in distribution. Its western periphery lies chiefly to the east of the principal California cordillera. But, unlike other species of similar distributional affinities (e.g., *formosa-pattoni*, fig. 41, which has reached but not crossed this barrier), it has invaded the foothill areas adjacent to the San Joaquin Valley of California apparently by way of the Tehachapi Pass. It would appear that the resulting population pressures have been sufficient to prevent subsequent invasions, and therefore there is a trend towards homogeneity in the two populations.

Campos (1929, p. 13) has recorded a "*Pepsis pallido-limbatae*" from several localities in Ecuador. It seems almost impossible that this chiefly Nearctic species occurs in South America, and, by the present writer, this is regarded as probably a misidentification.

Pepsis pallidolimbata pallidolimbata Lucas

Pepsis pallidolimbata LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 733, 745-747, pl. 32, figs. 162, 164 (female, "Nordwest Amerika"). Fox, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141, 145 (female, Texas). VIERECK, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 239 (New Mexico: Magdalena Mountains). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 259 (female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, p. 151. BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (female, *nec* male which is *thisbe*).

Pepsis bequaerti SALMAN, 1928, Pan-Pacific Ent., vol. 5, pp. 23-25 (male, Texas: Valentine, Presidio County, Sierra Blanca, Sheffield; New Mexico: Lordsburg; Arizona: Nogales; Mexico).

Pepsis cinnabarina, MCKENZIE, 1933, Pan-Pacific Ent., vol. 9, p. 159 (California: Twenty-nine Palms). (*Nec* Lucas, 1895, p. 804.)

Pepsis pallidolimbata pallidolimbata, HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 124, 126, 140-142 (male, female, California).

Wings pale lemon yellow to yellowish brown, thickly clothed with yellow and orange tomentose hairs; exterior submarginal dark band of forewing, if present, very narrow, pale, blackish brown; exterior mar-

ginal band of hind wing, if present, narrow, but somewhat broader and more intensely colored than exterior submarginal dark band of forewing, otherwise whitish hyaline; iridescent tomentum of head, thorax, abdomen, and legs characteristically pale green, rarely blue-green or purple.

GEOGRAPHIC RANGE: Northern Mexico, including Lower California, northward into western Texas, New Mexico, and Utah, thence westward into southeastern California (fig. 47).

This subspecies is easily recognized by the pale, lemon yellow to yellowish brown wings, the complete lack, or almost so, of an exterior submarginal dark band on the forewing, and the very brilliant, iridescent green tomentum of the body. In this last respect it is separable from all other species of the genus known from the Nearctic area. Significantly, the northwestern extension in distribution (fig. 47) terminates in the arid or desert regions of southern California, being geographically replaced on the foothills adjacent to the San Joaquin Valley of California by a distinctive differentiation unit, *smithi*. It is most assuredly parental to this northern unit, owing to the nature and extent of its distribution. The nominate subspecies lacks the homogeneity of expression found in the subspecies *smithi*, suggesting therefore the retention of a greater degree of plasticity which may be correlated with the more diversified climatic conditions in its geographical range.

The two records of this subspecies from Kansas are based upon male specimens contained in the collections of the University of Kansas and Kansas State College. One is a male labeled from Clark County and is dated May of 1902 (F. H. Snow) and the other bears a label from Manhattan and is dated May 13, 1948, without an indication of a collector other than "from student." It seems likely that both of these records are incorrect, as can be seen by reference to the distributional map of *pallidolimbata* (fig. 47).

***Pepsis pallidolimbata smithi* Hurd**

Pepsis pallidolimbata smithi HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 124, 142-143 (male, female, California: Corral Hollow, Alameda County, Tesla, Del Puerto Canyon, Mount Diablo).

Wings yellowish brown, but red or reddish in appearance owing to greater number of tomentose hairs so colored; exterior marginal band of forewing narrow, but not clearly whitish hyaline, infuscated with black, in some specimens heavily infuscated with black. Head, thorax, abdomen, and legs clothed with deep blue-green, almost blue, iridescent tomentum, much darker than that of the nominate subspecies.

GEOGRAPHIC RANGE: San Joaquin Valley flanks of the Sierra Nevada and Coast Range Mountains of California (fig. 47).

Smithi occupies the most restricted geographic area of any subspecies of *Pepsis* known to occur in the Nearctic area. It appears to have developed from an ancestral stock which invaded the foothill areas of California adjacent to the San Joaquin Valley as far northward as central California. Undoubtedly differentiation has been accomplished partly through isolation afforded by the transverse cordilleran system, which traverses its southern periphery and which has served to reduce contiguous contact with the parental subspecies, and partly through the significantly different climatic conditions prevailing in the distributional area occupied by *smithi*. Intergradation with the parental differentiation unit has been observed only in the Tehachapi Pass region, and because of this our knowledge of the interracial relationships is incomplete, but since the variation as expressed by the northern differentiation unit is correlated with geography, there appears but little doubt that *smithi* is best regarded as a subspecies.

In appearance, *smithi* is very reminiscent of *chrysothemis* both in general habitus and colorational features. It differs primarily from *pallidolimbata*, *sensu stricto*, in its smaller average size, darker body color, and in the lack, or very nearly so, of the clearly whitish hyaline exterior marginal band of the forewing. The smaller average size may be correlated with a corresponding decrease in the size of the host.

***Pepsis mexicana* Lucas**

Pepsis mexicana LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 560, 561, 566-568, pl. 33, fig. 174 (male, female, Mexico: Cuernavaca). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos

Aires, vol. 26, pp. 243, 244 (male, female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 35, 37, 38, 155, 168, pl. 2, fig. 10 (male, female, Colombia). BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 22 (male, female, United States). HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 124, 126, 145-146, fig. 1 (male, female, California: Prado, Hemet, Goffs, Laguna Beach).

Small- to medium-sized species. Wings predominantly melanochromatic, heavily infuscated with dark brown, thickly clothed with minute, iridescent blue, green, and purple tomentose hairs, especially on forewings, less so on hind wings; certain areas strongly violaceous in bright lights; exterior marginal band of forewing distinctly whitish hyaline, narrow, broadest at apex, occupying less than one-third of the width of area external to closed wing cells, narrowing posteriorly, disappearing near middle of anal cell; whitish hyaline exterior marginal band of hind wing somewhat broader than that of forewing, infuscated in females, never clearly whitish hyaline. Antennae black or brownish black. Vestiture, excepting iridescent tomentum, black or brownish black, short, mostly erect, greatest development occurs on head, including clypeus, pronotum, thoracic pleurites, propodeum, coxae, and abdominal sternites; legs bare, or nearly so.

MALE: Head, antennae with broad-band type of flagellar sensorial areas (fig. 4); first flagellar segment of antennae much shorter than distance between eyes at level of posterior ocelli; anterior ocellus slightly larger than posterior ocelli; clypeal margin gently incised; distal segments of labial and maxillary palpi generally longer than their adjacent segments; antennocellar groove complete, distinct; occipital carina incomplete, terminating considerably before the preular suture. Thorax, pronotal shoulders very prominent, almost dentate; posterior margin of pronotum angulate; mesopleural tubercles very distinct, dentate; propodeum not abruptly declivous behind; subspiracular tubercles poorly developed; lateral propodeal teeth evident, weakly tuberculate; inner spur of middle and hind tibiae considerably less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (fig. 22) brown or

black, narrow, attenuated posteriorly; apical margin bent downward, carinate, obtusely angled, sharp, though frequently excavated medially, hirsute on posterior surface; subapical transverse carina erect, angulate, abruptly decreasing in height at approximately its radius from lateral margins of subgenital plate, thence extending anterolaterally as a low, thickened ridge on either side of the subgenital plate, thereby delimiting a convex surface; area between apical and subapical transverse carinae excavated, shiny, lateral portions of which are separated by a low medio-longitudinal carina which disappears posteriorly. Genitalia as illustrated (fig. 37).

FEMALE: Very similar to male; differs chiefly in the poorer development of the mesopleural tubercles, and in having the last segment of the labial palpi generally much shorter than the adjacent segment.

GEOGRAPHIC RANGE: Colombia northward into western Texas, westward into southern California and Lower California (fig. 48).

This dark-winged species is not easily confused with any of our Nearctic species of *Pepsis*. *Mexicana* is one of our smallest species and presents a very uniform habitus in that the colorational expression appears to be constant. The black antennae, the narrow, whitish hyaline, exterior wing margins of both forewings and hind wings, and the possession of the distinctive subgenital plate serve to separate this species. Its closest relative appears to be *pertyi*, but until the status of our Central American *Pepsis* is more fully known, such an indication of relationship must be regarded as purely provisional.

Pepsis chrysothemis Lucas

Pepsis chrysothemis LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 731, 739-741, pl. 26, figs. 35, 43, pl. 30, figs. 85, 86, 92, pl. 31, fig. 83, pl. 32, fig. 133 (male, Mexico; Texas).

Pepsis cinnabarina LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 782, 804, pl. 32, fig. 146, pl. 33, figs. 180, 224 (female, Mexico; California: Coulterville).

Small- to medium-sized species. Geographically ditypic. Wings predominantly xanthochromatic; males with extreme apices

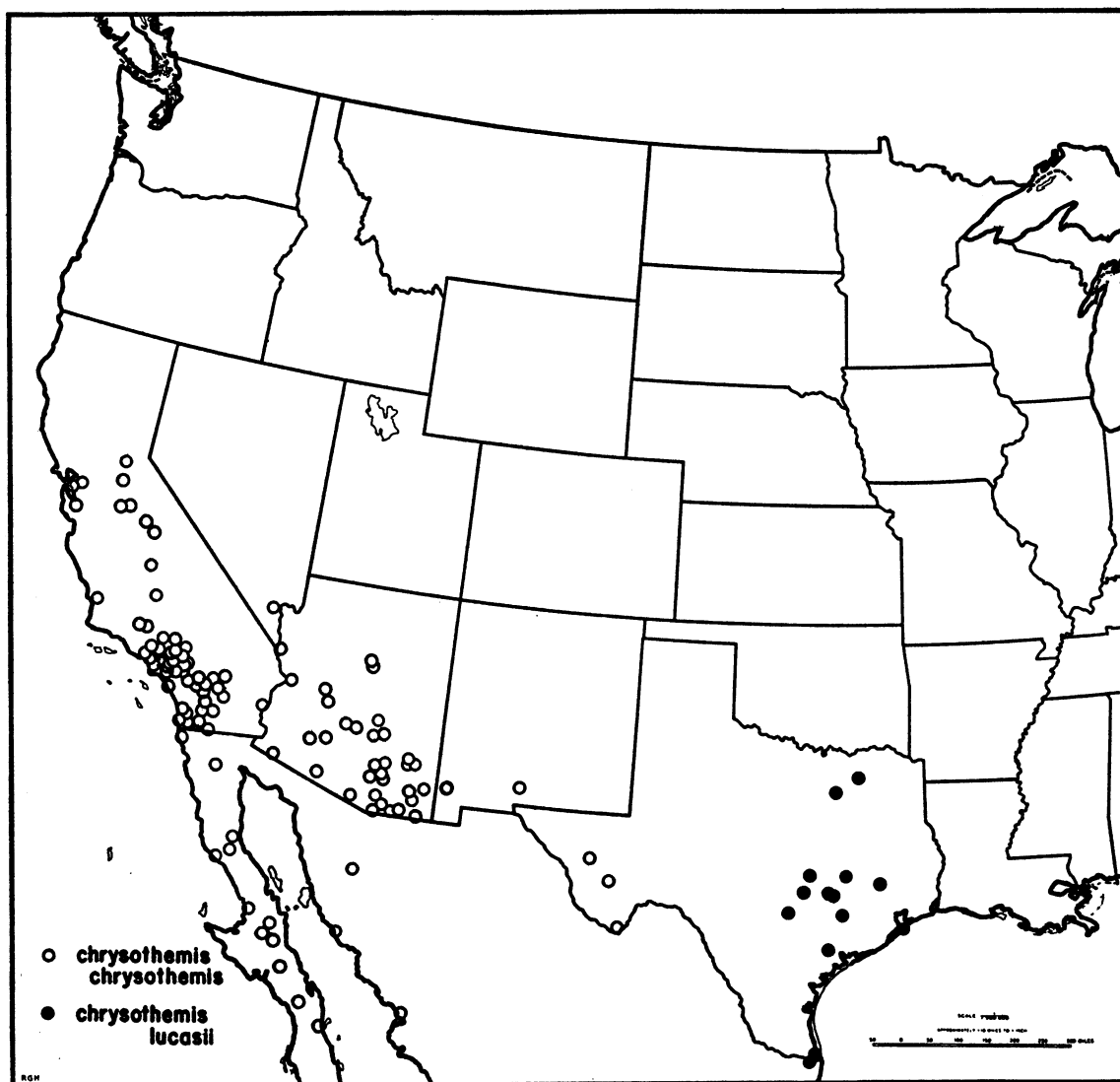


FIG. 48. Distribution of *Pepsis mexicana* Lucas.

of forewings narrowly whitish hyaline, apices of hind wings sometimes infuscated with brown or black, exterior marginal dark band of forewing darkest along radial vein and apex of marginal cell, extends posteriorly and marginally to axillary excision, external marginal dark band of hind wing begins before transverse cubital vein and extends posteriorly to its union with humeral band; humeral bands broad; females with apices of forewing and hind wing completely infuscated with black, not whitish hyaline; humeral bands narrower than in male, almost obsolete on hind wings. Antennae

black or brownish black. Vestiture, excepting iridescent tomentum, relatively sparse in male, much more hairy in female, restricted principally to head, including clypeus, pronotum, thoracic pleurites, coxae, and under surfaces and apex of abdomen; legs bare, or at most with a few scattered hairs on femora above.

MALE: Head, antennae with broad-band type of flagellar sensorial areas (fig. 4) though sometimes bipartite (fig. 5); first flagellar segment of antennae shorter than distance between eyes at level of posterior ocelli; anterior ocellus somewhat larger than

FIG. 49. Distribution of *Pepsis chrysothemis* Lucas.

posterior ocelli; clypeal margin evenly concave to angularly incised; distal segment of labial palpus as long as, or shorter than, adjacent segment; distal segment of maxillary palpus frequently longer than adjacent segment; antennocellar groove complete, distinct; occipital carina incomplete, not attaining the preular suture though sometimes nearly so. Thorax, pronotal shoulders prominent, but rounded, almost transverse; hind margin of pronotum generally arcuate; mesopleural tubercles evident, though characteristically poorly developed; propodeum

almost abruptly declivous behind; subspiracular tubercles scarcely evident; lateral propodeal teeth usually present, somewhat tuberculate; inner spur of middle and hind tibiae considerably less than one-half of length of the respective basitarsi. Abdomen, ventral hair brushes absent. Subgenital plate (fig. 23) trapezoidal, attenuated posteriorly, dark blackish brown, minutely punctate, devoid of pubescence (though in some sparsely pubescent); apical margin bent downward, angularly notched medially, posterolateral projections somewhat dentate, evenly

rounded; subapical transverse carina short, nearly vertical on posterior surface, but sloping forward on anterior surface, laterally bent forward, abruptly decreasing in height, then extending anterolaterally as a low, thickened ridge which delimits a raised, convex surface; area between apical and subapical transverse carinae traversed medio-longitudinally by a low carina, lateral areas so formed are smooth, shiny, sloping to lateral margins of the subgenital plate. Genitalia as illustrated (fig. 38).

FEMALE: Agrees quite closely with the male; differs chiefly in colorational features of the wings, discussed above.

GEOGRAPHIC RANGE: Northern Mexico, including Lower California, northward into Texas, westward to the Pacific coast (fig. 49).

Chrysothemis is clearly related to *pallidolimbata* and *thisbe*. The genitalic characters of the male and the nature and extent of the occipital carinae of the female seem to indicate, however, a closer relationship with *pallidolimbata*. The species is divisible into two subspecies.

Fox (1898, p. 144) described a new species, *circularis*, from Texas and based it apparently upon a single male specimen. The sixth abdominal sternite is stated to be covered by a large chitinous plate, the posterolateral angles of which are drawn out into a fold which completely encircles the sixth abdominal tergite. In his key, Fox separated *circularis* in such a manner as to suggest he had more than one specimen. However, Salman (MS, pp. 161-162) was able to locate only the type and found it to agree with *chrysothemis*. Unfortunately, the posterior third of the abdomen is smeared with shellac, hence Salman was unable to study the structure of the sixth abdominal sternite. From the characters presented in the original description and those utilized in the key provided by Fox, and more particularly Fox's remarks concerning the subgenital plate, there is little doubt that *circularis* is equivalent to *chrysothemis*. The most unusual condition ascribed to the sixth abdominal sternite, if correct, is very suggestive to this writer of an example of teratology. No specimens exhibiting this condition were encountered in the thousands of specimens examined in the present study.

Pepsis chrysothemis chrysothemis Lucas

Pepsis rubra, Fox, 1893, Proc. California Acad. Sci., ser. 2, vol. 4, p. 9 (male, female, Mexico: Lower California: San José del Cabo, Calmalli Mines; Sonora: Hermosillo); 1894, *ibid.*, ser. 2, vol. 4, p. 101 (male, female, Lower California; San José del Cabo, Todos Santos); 1895, *ibid.*, ser. 2, vol. 5, p. 265 (male, female, Lower California: San José del Cabo). (*Nec* Drury, 1773, p. 75, in part *thisbe*, q.v.)

Pepsis sommeri, PATTON, 1894, Proc. Ent. Soc. Washington, vol. 3, p. 47 (male, California: Poway). (*Nec* Dahlbom, 1845, p. 465).

Pepsis chrysothemis LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, pp. 731, 739-741, pl. 26, figs. 35, 43, pl. 30, figs. 85, 86, 92, pl. 31, fig. 83, pl. 32, fig. 133 (male, Mexico; Texas). Fox, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 142, 144-145 (male, Texas; Oklahoma; California; Lower California). VIERECK, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 232 (Arizona: Congress Junction). BANKS, 1912, Jour. New York Ent. Soc., vol. 19, p. 237 (male, *nec* female). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 258 (male). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 108, 110-111, 154, 170, pl. 1, fig. 27, pl. 2, fig. 50 (male, Brazil). BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 22 (male). HURD, 1948, Univ. California Publ. Ent., vol. 8, pp. 124, 126, 136-140, figs. 1, 4 (male, female, California: many records).

Pepsis cinnabarina LUCAS, 1895, Berliner Ent. Zeitschr., vol. 39, p. 804, pl. 32, fig. 146, pl. 33, figs. 180, 224 (female, Mexico; California: Coulterville). Fox, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141, 148 (female, Lower California; California: San Diego). VIERECK, 1906, Trans. Amer. Ent. Soc., vol. 32, p. 231 (female, Arizona: Oak Creek Canyon). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, pp. 266, 350 (female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 135, 136, 141-142, 154, pl. 2, figs. 71a, b, c, pl. 3, fig. 39. BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (female, *nec* male which is *thisbe*, q.v.). WISHERED AND MURAYAMA, 1929, Natl. Geogr. Mag., vol. 56, p. 49, pl. 10, fig. 4.

Wings yellowish brown, but bright fiery red in appearance owing to greater number of tomentose hairs so colored; male with exterior marginal dark band of forewing relatively narrow, occupying one-half or more of area external to closed wing cells, sometimes partially extending into closed wing cells, exterior marginal dark band of hind wing similar in nature and extent to that of

forewing, humeral band of forewing black or blackish brown, usually one-third of length of median cell, humeral band of hind wing similar to that of forewing in coloration, but extends fully three-fourths of length of median cell; female with colorational features very similar to those of male, but exterior marginal dark bands of forewings and hind wings restricted to area external to closed wing cells.

GEOGRAPHIC RANGE: Northwestern Mexico, including Lower California, northward into western Texas and westward into California (fig. 49).

Chrysothemis, *sensu stricto*, differs from *lucasii* chiefly in having the wings bright, fiery red and in being on the average larger in size. The mesopleural tubercles are slightly more produced, and the vestiture appears to be somewhat more dense. The female agrees with *lucasii* in having the first flagellar segment distinctly shorter than the distance between the eyes at the level of the posterior ocelli. No differences in the male genitalia or in the subgenital plate were noted. In the male, the exterior submarginal dark band of the forewing is quite noticeably narrower than that of *lucasii* males.

***Pepsis chrysothemis lucasii* Fox, new status**

Pepsis sanguigutta, Fox, 1898, Proc. Ent. Soc. Washington, vol. 4, p. 143 (male, Texas). (*Nec* Christ, 1791, p. 293.)

Pepsis lucasii Fox, 1898, Proc. Ent. Soc. Washington, vol. 4, pp. 141, 145-146 (female, Texas). BRÈTHES, 1914, An. Mus. Nac. Hist. Nat. Buenos Aires, vol. 26, p. 267 (female). LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 155, 171. BANKS, 1921, Ann. Ent. Soc. Amer., vol. 14, p. 23 (female). BRADLEY, 1944, Notulae Nat., Acad. Nat. Sci. Philadelphia, no. 145, p. 8 (female, Mexico: Tamaulipas, Alta Mira near Tampico).

Wings yellowish brown, but fulvous in appearance owing to predominance of yellow and orange tomentose hairs; male with exterior marginal dark band very broad, extending well over one-half of the distance into third submarginal cell, exterior marginal dark band of hind wing similar in extent and nature, sometimes almost completely obliterating fulvous coloration, humeral bands of both forewings and hind wings

very broad, occupying fully three-fourths or more of respective median cells; females with exterior marginal dark band of forewing and hind wing relatively narrow as compared with male, but occupying most of area external to closed wing cells.

GEOGRAPHIC RANGE: Northeastern Mexico, northward into eastern Texas (fig. 49).

Lucasii, previously known only from the female sex, was described as a full species, differing primarily from the other Nearctic species in its smaller size, by not having the wings heavily margined with black, but with the predominant wing color "gradually coalescing with the subfuscous of the apical portions of the wing," and in having the first two antennal segments shorter than the distance between the eyes at the level of the posterior ocelli. The structural characteristics of *lucasii* then, are very suggestive of those of *chrysothemis*, *sensu stricto*, females, and a comparative study of their morphology demonstrated a very close relationship. When the localities for males assignable to *chrysothemis*, *sensu lato*, were plotted on a map it was learned that in the eastern portion of the geographic range, in particular southeastern Texas and northern Mexico, no females of the western form, *chrysothemis*, *sensu stricto*, occurred. A more critical examination of *chrysothemis* males from this area revealed that they differed from their western counterparts in their smaller average size, darker wing coloration, and in the greater width of the exterior submarginal dark band of the forewing. A comparison of the distribution data obtained from these males and from *lucasii* females showed a high incidence of superposition both as to locality and date of capture, and hence the two are regarded as sexes of one form, the subspecies *lucasii*. Morphologically there does not appear to be any appreciable differences between *lucasii*, new status, and *chrysothemis*, *sensu stricto*, and owing to their allopatric distribution they are considered as subspecies.

It is quite evident that the male of *lucasii* was recorded by Fox (1898, p. 143) as *sanguigutta*, a West Indian species of remarkably similar habitus, for specimens upon which this report was based have been seen and are referable to *chrysothemis lucasii*.

SPECIES OF DOUBTFUL NEARCTIC OCCURRENCE

The following species of *Pepsis* are excluded from the present treatment, since records of their occurrence in the Nearctic area are open to serious question. The majority of these reports are based on misidentifications, a fact that has been established in many instances by an examination of the specimen or specimens on which these records rest. Wherever possible, these misidentifications have been cited in the preceding synonymical bibliographies of the species concerned. The remainder are excluded primarily on the grounds of obviously erroneous geographical citations.

Pepsis atalanta Mocsáry, 1885, p. 267

The geographic citation "Am.: Colorado" appears to be an error by Dalla Torre (1897, p. 247), since the species is known to occur only in Colombia and Venezuela.

Pepsis charon Mocsáry, 1885, p. 255

Fox (1898, p. 143) recorded a single male of this Central American species from Texas. Banks (1921, p. 23) cited this record but excluded it from his key to the species of *Pepsis* known to him from the United States. Neither Salman (MS, p. 163) nor the present writer has seen the specimen on which this record is based or any specimens of this species from the area under consideration. While it is not an impossibility that *charon* does occur in the Nearctic area, the likelihood is that the Fox record is referable to *Pepsis elegans* Lepeletier, 1845, p. 489.

Pepsis coerulea (Linnaeus, 1758, p. 571)

Cresson (1875, p. 713) and Patton (1879, p. 351) record a "*Pepsis coerulea*" from several localities within the United States. However, an examination of specimens on which these authors based their determinations shows them to be *Pepsis thisbe* Lucas (1895, p. 744). The Linnaean species *coerulea* is no longer regarded as a member of the genus *Pepsis*.

Pepsis cupripennis Taschenberg, 1869, p. 28

Recorded by Lucas (1895, p. 725) from "Orizaba, Texas," but this was probably intended for Orizaba, Mexico, since the

material was collected by Bilimek who collected only in Mexico.

Pepsis cyanea (Fabricius, 1775, p. 346)

Palisot de Beauvois (1806, p. 38) recorded this species from the "United States," but *cyanea* has been shown not to be a species of the genus *Pepsis*.

Pepsis domingensis Lepeletier, 1845, p. 477

This West Indian species was reported from Oak Creek, Arizona, by Snow (1907, p. 132), but a study of the two specimens upon which this record was based has shown them to be *Pepsis arizonica* Banks (1921, p. 21).

Pepsis luteicornis Fabricius, 1805, p. 214

Recorded from South Carolina by Palisot de Beauvois (1806, p. 39), and the record was subsequently cited by Cresson (1863, p. 318). Cresson (1867, p. 145) states that the species is generally found in South America, and the locality given by Palisot de Beauvois may be erroneous, a position also maintained by him in a later publication (1887, p. 149). It appears to the present writer that the record is most likely referable to *Pepsis elegans* Lepeletier (1845, p. 489).

Pepsis montezuma Smith, 1855, p. 199

While it is not unlikely that this species may eventually be found in the United States, the eight specimens recorded by Snow (1907, p. 132) from Oak Creek and San Bernardino Ranch, Arizona, have been examined and found to be *Pepsis angustimarginata* Viereck (1908, p. 389).

Pepsis obliquerrugosa Lucas, 1895, p. 576

This name was applied by Fox (1898, p. 143) and Banks (1921, p. 22) to our southwestern United States form, *pattoni* Banks (1944, p. 181), prior to its description as a separate species. *Pattoni* has been relegated in the present paper to a subspecies of *Pepsis formosa* (Say, 1823, p. 76).

Pepsis ornata Lepeletier, 1845, p. 486

Cresson (1875, p. 713) and Fox (1893, p. 9) specimens bearing the determination

label "*Pepsis ornata* Pel" have been studied and have been found to be misidentifications for *Pepsis formosa pattoni* Banks (1944, p. 181).

Pepsis rubra (Drury, 1773, p. 75)

This West Indian species has been confused with *Pepsis formosa formosa* (Say, 1823, p. 76) by Mocsáry (1885, p. 245) and with *Pepsis thisbe* Lucas (1895, p. 744) by Cameron (1893, p. 218), as is indicated by the remarks of the former and the figure supplied by the latter. Specimens of this very distinctive species have not been seen by the writer from the North American mainland.

Pepsis sanguigutta (Christ, 1791, p. 293)

Lucas (1895, p. 728) has recorded this West Indian species from Texas as has Fox (1898, p. 143). It is quite evident from the descriptive remarks of Fox that his record is based upon the previously unrecognized male of *Pepsis chrysothemis lucasii* Fox (1898, p. 141). Such may also be the case with the Lucas record, since *lucasii* males bear a strikingly superficial resemblance to those of *sanguigutta*.

Pepsis sommeri Dahlbom, 1845, p. 465

The alleged occurrence of this Central American species in the United States rests upon a single male specimen determined as that species by Patton (1894, p. 47). From his description of the specimen, in particular the characterization of the subgenital plate, there is no doubt that the specimen and its record are referable to *Pepsis chrysothemis chrysothemis* Lucas (1895, p. 739).

Pepsis sulphureicornis Palisot de Beauvois, 1809, p. 95

Ashmead (1900, p. 309) has recorded this species from the United States, but in the opinion of the present writer this record is most likely referable to *Pepsis elegans* Lepeletier (1845, p. 489).

Pepsis terminata Dahlbom, 1844, p. 120

Fox (1894, p. 100; 1895, p. 265), finding that his earlier record (1893, p. 9), reported as *Pepsis ornata* Lepeletier (1845, p. 486), was equivalent to *terminata*, adopted the latter name. Later (1898, p. 143), when the Lucas (1895) monograph appeared, he ascribed all these records to *Pepsis obliquerrugosa* Lucas (1895, p. 576). For remarks concerning the status of this last-named form, see discussion of *obliquerrugosa* above.

NOMENCLATORIAL CONSPECTUS OF THE GENUS *PEPSIS* FABRICIUS

DURING THE COURSE of investigations on the genus it became apparent that there was a real need for a list of the names that have been applied in *Pepsis*. This need was first felt when the writer attempted to organize the literature on the Nearctic species, especially when a preliminary search revealed that well over 500 names have been applied in the genus.

Numerous species have been described since the turn of the century, particularly by Brèthes (1908, 1914) and Banks (1946). Descriptions of new species by these and other authors have in some instances been overlooked by the "Zoological record." Lucas (1919) published a list of the names for the valid species known by him to that date. In some respects it appears that a partial attempt was made to include some of the synonyms and certain of the names which had been previously applied in the genus, but were regarded as assignable to *Pepsis* on one ground or another. However, the list was, even for that date, quite incomplete and to a large extent unreliable. For this reason several nomenclatorial cases requiring rectification have been discovered, the results of which have been published elsewhere (Hurd, 1950). As indicated therein, only such nomenclatorial changes as were absolutely necessary were made. Other nomenclatorial problems remain, as can be seen by reference to the accompanying lists, but owing to the zoological status of the names involved it seems inadvisable to attempt to solve them.

The following portion of the paper is divided into three main sections. The first is an alphabetical list of the names currently applied in *Pepsis*, with bibliographical citations to each of the names. In this section, as well as in the subsequent ones, the original orthography of the name is followed. *Lapsi calami*, transliterations, emendations, and typographical errors, in spite of the fact that they abound in the literature, are disregarded except for agreement in gender and number.

Such irregularities have no place in our present system of zoological nomenclature, hence are rejected, but, wherever applicable, are embodied in the bibliographical synonymies of the species concerned, simply as a matter of reference.

I have attempted to superimpose on this first list such collateral information as is fundamental for the work of any future investigator. Therefore, the names of taxonomic entities that are now regarded as synonyms or renamed homonyms are italicized, and reference is made to the present allocation of these entities. Similarly, those that are regarded as infraspecific in nature are so indicated, with a definite citation as to their present taxonomic status. The sex symbols following each name denote our present knowledge of the entity in question and do not necessarily indicate the sex or sexes on which the original description was based. Subgeneric assignments are provided for the species as designated in the existing literature; no attempt is made to assign any of the Nearctic species not previously allocated, nor are subgeneric assignments indicated for the species falling within *Pepsis*, *sensu stricto*. Distributional information is presented for the names that are in themselves recognized as valid, nomenclatorially and/or taxonomically, by means of political areas or regions. These data are based solely on the literature, including that of the present revision.

The second section deals with names applied in the genus, originally or secondarily, but which are no longer included on the evidence that they represent members of other categories.

In the last section a résumé of the eight subgenera of the genus, not including the nominate subgenus, is presented. The names, irrespective of their taxonomic level, are listed alphabetically under the assigned subgenus. Those names that represent synonyms are included and italicized under the subgenus in which their equivalent appears.

NAMES CURRENTLY APPLIED IN *PEPSIS*

- abrupta Brèthes, 1908, p. 239, ♂, Argentina
 accipitrinus Hurd, 1950, p. 132, ♀, Brazil
 aciculata Taschenberg, 1869, p. 29, ♀, =limbata
 Guérin-Méneville, 1831, p. 255
 acroleuca Lucas, 1895, p. 730, ♂ [♀?], unknown
 advena Mocsáry, 1885, p. 256, ♀, "America
 meridionalis," Brazil
 aen(e)ipennis Banks, 1946, p. 372, ♂ ♀, [*Steno-
pepsis*], Colombia, Peru
 affinis Dahlbom, 1845, p. 464, ♀, Surinam
 albocincta Smith, 1855, p. 192, ♂ ♀, Colombia,
 Brazil
 albolimbata Mocsáry, 1885, p. 250, ♂, [*Steno-
pepsis*], Ecuador, Brazil
 alceste Banks, 1946, p. 388, [♀?], Peru
 alcimeda Banks, 1946, p. 318, ♀, [*Gigantopepsis*],
 Bolivia
 alector Banks, 1946, p. 370, ♀, [*Stenopepsis*],
 Peru
 alitarsus Enderlein, 1901, p. 147, ♂, =gigantea
 Lucas, 1895, p. 575
 amabilis Mocsáry, 1885, p. 253, ♂ ♀, Mexico,
 Guatemala, British Honduras, Panama, Co-
 lombia, Venezuela, Ecuador, Peru, Brazil
 amalthea Banks, 1946, p. 319, ♀, [*Gigantopepsis*],
 Brazil, Bolivia
 amautas Banks, 1946, p. 389, ♂, Peru
 ameghinoi Brèthes, 1908, p. 240, ♀, Argentina
 amok Lucas, 1919, p. 66, ♀, Panama
 amyntas Mocsáry, 1885, p. 241, ♂ ♀, [*Steno-
pepsis*], Peru, Brazil, Bolivia, Paraguay, Argen-
 tina
 amyntoides Lucas, 1919, p. 22, ♂, Brazil
 andicola Cameron, 1903, p. 226, ♀, =quintonensis
 Packard, 1869, p. 61
 andina Brèthes, 1908, p. 234, ♂ ♀, [*Cirripepsis*],
 Peru, Argentina
 andrei Mocsáry, 1885, p. 267, ♀, Guatemala
 angusta Banks, 1946, p. 390, ♂, Colombia
 angustimarginata Viereck, 1908, p. 389, ♂ ♀,
 United States, Mexico
 anisitsii Brèthes, 1908, p. 234, ♀, Paraguay
 annae-erdmuthae Lucas, 1919, p. 118, ♂ ♀, Ar-
 gentina
 antennalis Cameron, 1893, p. 217, ♀, Panama
 apicalis Gray, 1832, p. 516, ♂, =festiva Fa-
 bricius, 1805, p. 214
 apicalis Lepeletier, 1845, p. 472, ♀, renamed
 somatochlora Hurd, 1950, p. 133
 apicata Taschenberg, 1869, p. 28, ♀, Brazil
 apollonis Brèthes, 1908, p. 240, ♀, Argentina
 aquila Lucas, 1895, p. 797, ♂, United States,
 Mexico
 arechavaletai Brèthes, 1908, p. 237, ♂, Argentina
 aretheas Brèthes, 1914, p. 331, ♀, [*Nannopepsis*],
 Paraguay, Argentina
 argentina Brèthes, 1908, p. 233, ♂, Argentina
 argentinica Strand, 1910, p. 16, ♂, Argentina
 arizonica Banks, 1921, p. 21, ♂ ♀, United States,
 Mexico
 assimilis Banks, 1946, p. 343, ♀, [*Deropepsis*],
 Trinidad
 astarte Banks, 1945, p. 87, ♂, [*Gigantopepsis*],
 Colombia
 asteria Mocsáry, 1894, p. 4, ♀, Peru, Brazil
 astioles Banks, 1946, p. 355, ♀, [*Cirripepsis*], Co-
 lombia
 atahualpa Banks, 1946, p. 328, ♂, [*Trichopepsis*],
 Peru
 atalanta Mocsáry, 1885, p. 267, ♀, Colombia,
 Venezuela
 ataraqua Banks, 1946, p. 389, [♀?], Bolivia
 atrata Lepeletier, 1845, p. 470, ♂ ♀, [*Deropepsis*],
 Venezuela, British Guiana, French Guiana
 atricoma Hurd, 1950, p. 132, ♀, South America
 atripennis Fabricius, 1805, p. 216, ♀, "America
 meridionalis"
 atrovirens Lucas, 1895, p. 507, ♂, Brazil
 auranticornis Lucas, 1895, p. 605, ♂ ♀, Mexico,
 Guatemala, Brazil
 auricoma Lucas, 1895, p. 489, ♂, Brazil
 aurifex Smith, 1855, p. 191, ♂, [*Gigantopepsis*],
 Brazil, Bolivia
 auriguttata Burmeister, 1872, p. 234, ♀, Brazil
 aurimacula Mocsáry, 1885, p. 262, ♀, [*Cirripepsis*],
 Brazil
 auripennis (De Geer), 1773, p. 583, ♀, West In-
 dies
 aurocincta Mocsáry, 1894, p. 1, ♂, Brazil
 aurozonata Smith, 1855, p. 191, ♂, [*Gigantopep-
sis*], Brazil
 australis Saussure, 1868, p. 65, ♀, [*Stenopepsis*],
 Brazil
 avitula Cockerell, 1941, p. 355, Miocene
 [Oligocene?]; Florissant, Colorado
 azteca Cameron, 1893, p. 215, ♂ ♀, United States,
 Mexico, Honduras, Nicaragua, Costa Rica,
 Panama
 bahiae Brèthes, 1914, p. 288, ♀, Brazil
 balboae Lucas, 1919, p. 51, ♀, Panama
 balloui Banks, 1946, p. 391, ♂, Trinidad
 bang-haasi Lucas, 1919, p. 151, ♀, Argentina
 basalis Mocsáry, 1885, p. 241, ♂, Colombia
 basifusca Lucas, 1895, p. 798, ♂, Mexico
 bequaerti Salman, 1928, p. 23, ♂, =pallidolimbata
 Lucas, 1895, p. 745
 bicarinata Lucas, 1895, p. 572; MS name cited in
 synonymy; isoholotypic with pertyi Lucas,
 1895, p. 572
 bicolor Lepeletier, 1845, p. 488, ♂, =pretiosa
 Dahlbom, 1844, p. 121
 boguei Fox, 1898, p. 146, ♂ ♀, =mildei Stål, 1857,
 p. 64

- bonariensis*, Lucas, 1895, p. 760, ♂ ♀, renamed *linsleyi* Hurd, 1950, p. 132
- bonplandi* Brèthes, 1914, p. 282, ♂, Argentina
- brasiliensis* Brèthes, 1908, p. 237, ♂ ♀, Brazil
- brèthesi* Montet, 1921, p. 216, ♂, unknown
- brevicornis* Mocsáry, 1894, p. 12, ♂, Brazil
- bruchii* Brèthes, 1908, p. 242, ♂, Argentina
- brunneicornis* Lucas, 1895, p. 510, ♂, Brazil
- burmeisteri* Brèthes, 1908, p. 242, ♂, Argentina
- calypso* Brèthes, 1908, p. 236, ♂, Paraguay, Argentina
- caridei* Brèthes, 1908, p. 240, ♂ ♀, Argentina
- carinata* Brèthes, 1914, p. 311, ♂, Ecuador
- cassandra* Mocsáry, 1889, p. 162, ♀, Chile
- cassiope* Mocsáry, 1889, p. 161, ♀, [Trichoepopsis], Colombia, Brazil, Bolivia
- centaurus* Lucas, 1897, p. 295, ♂, Brazil
- centralis* Cameron, 1893, p. 221, ♂ ♀, Guatemala, Panama
- cerastes* Lucas, 1895, p. 639, ♂, Brazil
- cereberus* Lucas, 1895, p. 790, ♂ ♀, United States, Mexico
- chacoana* Brèthes, 1908, p. 240, ♂, Argentina
- charon* Mocsáry, 1885, p. 255, ♂ ♀, Mexico, Guatemala, Nicaragua, Panama
- chiliensis* Lepeletier, 1845, p. 480, ♀, Chile
- chilloensis* Cameron, 1903, p. 227, ♀, = *quitenensis* Packard, 1869, p. 61
- chiron* Mocsáry, 1885, p. 266, ♂, Honduras
- chloe* Brèthes, 1914, p. 313, ♂, Argentina
- chlorana* Mocsáry, 1885, p. 262, ♀, Colombia, Brazil
- chloroptera* Brèthes, 1908, p. 236, ♂ ♀, Brazil, Argentina
- chlorotica* Mocsáry, 1885, p. 251, ♂, British Guiana, Brazil
- chrysobapta* Smith, 1855, p. 191, ♀, Brazil
- chrysochlamys* Mocsáry, 1894, p. 2, ♂ ♀, = *plutus* Klug, 1848, p. 588
- chrysoptera* Burmeister, 1872, p. 233, ♂, Argentina
- chrysothemis* Lucas, 1895, p. 739, ♂ ♀, United States, Mexico, Brazil
- chrysothorax* Brèthes, 1908, p. 233, ♀, Argentina?
- cinctipennis* Mocsáry, 1885, p. 265, ♀, Mexico, Guatemala
- cinnabarina* Lucas, 1895, p. 804, ♀, = *chrysothemis* Lucas, 1895, p. 739
- circe* Mocsáry, 1885, p. 263, ♂ ♀, [Trichoepopsis], Colombia, Venezuela, Argentina
- circularis* Fox, 1898, p. 144, ♂, = *chrysothemis* Lucas, 1895, p. 739
- citricornis* Mocsáry, 1894, p. 11, ♂, [Stenoepopsis], Colombia, Brazil
- clarinervis* Brèthes, 1908, p. 238, ♀, Argentina
- cleantes* Banks, 1946, p. 320, ♂ ♀, [Gigantopepsis], Bolivia
- cleone* Brèthes, 1914, p. 327, ♂, Argentina
- clotho* Mocsáry, 1889, p. 161, ♀, Panama, Brazil
- clypeata* Brèthes, 1914, p. 310, ♀, Ecuador
- cofanus* Banks, 1946, p. 364, ♂ ♀, [Stenoepopsis], Ecuador
- collaris* Kirby, 1884, p. 408, ♀, Brazil
- colossica* Stål, 1857, p. 64, Colombia
- comes* Banks, 1946, p. 342, ♀, [Deroepopsis], Brazil
- comparata* Brèthes, 1908, p. 239, ♂, Argentina
- completa* Smith, 1855, p. 190, ♂ ♀, British Guiana, Brazil, Bolivia, Paraguay, Argentina
- concava* Brèthes, 1908, p. 239, ♀, [Nannoepopsis], Brazil, Paraguay, Argentina
- concolor* Lucas, 1895, p. 693, ♂, Mexico
- confusa* Fox, 1897, p. 281, ♂, Brazil
- consimilis* Banks, 1946, p. 369, ♀, [Stenoepopsis], Ecuador, Peru
- consors* Banks, 1946, p. 352, ♀, [Nannoepopsis], Bolivia
- convexa* Lucas, 1895, p. 689, ♀, Brazil
- copelloi* Brèthes, 1914, p. 317, ♀, Uruguay
- cordata* Brèthes, 1914, p. 272, ♀, [Nannoepopsis], Argentina
- cordubensis* Brèthes, 1908, p. 243, ♀, Argentina
- cornuta* Lucas, 1895, p. 641, ♂, Brazil
- coronaria* Brèthes, 1914, p. 313, ♂, Brazil
- crassicornis* Mocsáry, 1885, p. 254, ♂ ♀, Brazil, Bolivia
- culta* Brèthes, 1908, p. 237, ♂, Brazil
- cultrata* Brèthes, 1908, p. 242, ♀, Brazil
- cupripennis* Taschenberg, 1869, p. 28, ♂ ♀, [Deroepopsis], Mexico, Brazil, Bolivia, Paraguay, Uruguay, Argentina
- curti* Lucas, 1919, p. 149, ♀, Panama
- cyanescens* Lepeletier, 1845, p. 485, ♂, unknown
- cyanoptera* Lucas, 1895, p. 590, ♂ ♀, Mexico, Colombia
- cyanosoma* Lucas, 1895, p. 557, ♂, [Stenoepopsis], Guatemala, Trinidad, Brazil
- cybele* Banks, 1945, p. 84, ♀, [Stenoepopsis], Colombia
- cylindrica* Lucas, 1895, p. 696, ♀, Brazil
- deaurata* Mocsáry, 1894, p. 2, ♂ ♀, Peru, Brazil
- debilitans* Lucas, 1919, p. 84, ♀, Brazil
- decepta* Banks, 1928, p. 4, variety of *domingensis* Lepeletier, 1845, p. 477
- decipiens* Lucas, 1895, p. 533, ♀, Brazil
- decipiens* Campos, 1929, p. 13, *nomen nudum*
- decolorata* Lepeletier, 1845, p. 474, ♀, French Guiana
- decorata* Perty, 1833, p. 143, ♂ ♀, Brazil, Argentina
- defecta* Taschenberg, 1869, p. 30, ♂, [Deroepopsis], Brazil, Paraguay, Argentina
- depressa* Brèthes, 1908, p. 243, ♀, Argentina
- deuteroleuca* Smith, 1855, p. 196, ♂ ♀, [Deroepopsis], West Indies, French Guiana, Venezuela, Brazil, Bolivia, Paraguay, Argentina

- diabolus* Lucas, 1895, p. 679, ♀, British Guiana, Brazil
diana Mocsáry, 1885, p. 260, ♀, Brazil, Peru, Bolivia
dilatata Brèthes, 1908, p. 234, ♂, variety of *andina* Brèthes, 1908, p. 234
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discoidalis Brèthes, 1914, p. 312, ♂ ♀, Argentina
discolor Taschenberg, 1869, p. 28, ♂ ♀, [*Deropepsis*], Ecuador, Brazil, Paraguay
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dromeda Brèthes, 1908, p. 238, ♀, Paraguay
dryas Lucas, 1919, p. 60, ♂, Panama
dubitata Cresson, 1867, p. 144, ♂ ♀, = *elegans* Lepeletier, 1845, p. 489
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ephebus Brèthes, 1908, p. 242, ♂, Argentina
equatoriana Brèthes, 1914, p. 315, ♂, Ecuador
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erdmanni Lucas, 1895, p. 516, ♂, [*Stenoepsis*], Colombia, Surinam, Brazil
erecta Brèthes, 1914, p. 299, ♂, Brazil, Peru, Bolivia
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erynnis Lucas, 1895, p. 669, ♀, Brazil
erythroceras Brèthes, 1914, p. 244, ♂, variety of *pertyi* Lucas, 1895, p. 572
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euchroma Lucas, 1895, p. 792, ♀, Mexico
eurydice Lucas, 1919, p. 23, ♂, Brazil
euterpe Brèthes, 1908, p. 242, ♂ ♀, [*Deropepsis*], Brazil, Argentina
excelsa Lucas, 1895, p. 592, ♂ ♀, West Indies, British Guiana, Brazil, Paraguay
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fasciculata Brèthes, 1908, p. 243, ♂ ♀, [*Trichopepsis*], Brazil, Peru, Paraguay, Argentina
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filiola Brèthes, 1914, p. 312, ♂, Argentina
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flaminia Brèthes, 1914, p. 332, ♂ ♀, [*Deropepsis*], Bolivia, Paraguay, Argentina
flavescens Lucas, 1895, p. 511, ♂, [*Stenoepsis*], Brazil, Paraguay, Uruguay, Argentina
flavicornis Mocsáry, 1894, p. 7, ♂, British Guiana, Brazil
flavilis Brèthes, 1908, p. 235, ♀, [*Stenoepsis*], Brazil, Bolivia
floralis Lepeletier, 1845, p. 491, ♂ ♀, Brazil
fluminensis Brèthes, 1908, p. 237, ♂, Brazil, Paraguay
fluorescens Lucas, 1895, p. 661, ♀, Brazil
formosa (Say), 1823, p. 76, ♂ ♀, United States, Mexico
foxi Lucas, 1897, p. 291, ♂ ♀, Brazil
fraterna Lucas, 1895, p. 676, ♂, Brazil
frivaldszkyi Mocsáry, 1885, p. 259, ♂ ♀, [*Deropepsis*], Trinidad, British Guiana, Brazil
fruhstorferi Lucas, 1895, p. 673, ♂, Honduras
fulgidipennis Mocsáry, 1885, p. 251, ♂ ♀, Trinidad, Colombia, Venezuela, British Guiana, Surinam, Brazil, Peru
fulva Lucas, 1895, p. 698, ♀, South America
fulvicornis Mocsáry, 1885, p. 252, ♀, Panama
fulvipennis Le Guillou, 1841, p. 319, ♀, = *limbata* Guérin-Ménéville, 1831, p. 255
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fusca (Christ), 1791, p. 256, unknown
fusca Lucas, 1895, p. 788, ♀, renamed *atricoma* Hurd, 1950, p. 132
fuscipennis Smith, 1873, p. 50, ♀, renamed *accipitrinus* Hurd, 1950, p. 132
fuscobasalis Brèthes, 1908, p. 242, ♂, Argentina, Paraguay
fuscorubra Brèthes, 1914, p. 321, ♀, Brazil
fusifformis Lucas, 1895, p. 620; MS name cited in

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- gallardoi* Brèthes, 1908, p. 236, ♀, Brazil, Peru, Paraguay, Argentina
- garbei* Brèthes, 1914, p. 297, ♀, Brazil
- gemella* Banks, 1946, p. 398, ♂, variety of *prixii* Brèthes, 1908, p. 240
- gigantea* Lucas, 1895, p. 575, ♂ ♀, [*Gigantopepsis*], Brazil
- glabripennis* Lucas, 1895, p. 613, ♀, [*Deropepsis*], Brazil, Paraguay
- gracilis* Lepeletier, 1845, p. 474, ♀, [*Stenopepsis*], British Guiana, French Guiana
- gracillima* Taschenberg, 1869, p. 30, ♀, Colombia, Venezuela
- grossa* (Fabricius), 1798, p. 245, ♂ ♀, [*Dinopepsis*], Trinidad, Colombia, British Guiana, Brazil
- guaranitica* Brèthes, 1908, p. 239, ♂ ♀, [*Deropepsis*], Brazil, Bolivia, Paraguay, Argentina
- guatemalensis* Cameron, 1893, p. 216, ♂ ♀, Guatemala
- guttata* Lucas, 1895, p. 532, ♀, variety of *aurimacula* Mocsáry, 1885, p. 262
- hecate* Mocsáry, 1885, p. 268, ♀, British Guiana, Brazil
- hecuba* Mocsáry, 1885, p. 252, ♀, = *xanthocera* Dahlbom, 1844, p. 120
- helvolicornis* Lucas, 1895, p. 585, ♀, Brazil
- herodes* Lucas, 1919, p. 52, ♀, Panama
- heros* (Fabricius), 1798, p. 245, ♀, [*Deropepsis*], Brazil, Ecuador, Peru
- heros* Dahlbom, 1844, p. 122, ♀, = *marginata* Palisot de Beauvois, 1809, p. 94
- hesperiae* Patton, 1894, p. 46, ♂, = *mildei* Stål, 1857, p. 64
- heterochroa* Brèthes, 1914, p. 298, ♀, Brazil
- hexamita* Lucas, 1895, p. 609, ♀, West Indies
- hirsuta* Salman, 1933, p. 9, ♀, = *arizonica* Banks, 1921, p. 21
- hirtiventris* Banks, 1946, p. 357, ♀, [*Cirripepsis*], Peru
- holmbergi* Brèthes, 1908, p. 234, ♂, Bolivia, Argentina
- hora* Brèthes, 1914, p. 289, ♀, Brazil
- huascar* Banks, 1946, p. 327, ♂, [*Trichoepsis*], Peru
- humeralis* Brèthes, 1914, p. 294, ♂, Brazil
- hyalinipennis* Mocsáry, 1885, p. 240, ♂, [*Stenopepsis*], Peru, Brazil
- hymenaea* Mocsáry, 1885, p. 257, ♂ ♀, [*Stenopepsis*], Colombia, Venezuela, Brazil
- hyperion* Mocsáry, 1894, p. 11, ♀, [*Deropepsis* and *Gigantopepsis*], Brazil
- ianthina* Klug, 1848, p. 588, ♀, Panama, Colombia, British Guiana, Surinam, Brazil, Ecuador, Peru, Bolivia, Argentina
- ichesii* Brèthes, 1908, p. 235, ♂, Argentina
- ierensis* Banks, 1945, p. 83, ♀, [*Stenopepsis*], Trinidad, Colombia, Ecuador
- ignicornis* Cresson, 1865, p. 134, ♂, variety of *domingensis* Lepeletier, 1945, p. 477
- iheringi* Brèthes, 1908, p. 238, ♀, Brazil
- ilione* Banks, 1946, p. 358, ♀, [*Cirripepsis*], Peru
- impatiens* Brèthes, 1914, p. 273, ♂, Brazil
- incendiaria* Lucas, 1895, p. 654, ♀, Brazil
- incerta* Banks, 1946, p. 369, ♀, [*Stenopepsis*], Peru
- inclyta* Lepeletier, 1845, p. 475, ♂ ♀, [*Dinopepsis*], Mexico, Brazil, Paraguay, Argentina
- incompleta* Brèthes, 1908, p. 234, ♂, Argentina?
- indistincta* Brèthes, 1908, p. 234, ♀, Brazil
- inermis* Fox, 1898, p. 146, ♀, = *cerberus* Lucas, 1895, p. 790
- infuscata* Spinola, 1841, p. 104, ♂, = *viridisetosa* Spinola, 1841, p. 104
- inimicissima* Lucas, 1919, p. 83, ♀, Brazil
- insignis* Mocsáry, 1885, p. 248, ♂, [*Stenopepsis*], Colombia, Brazil, Peru
- intermedia* Schrottkey, 1902, p. 314, ♂, = *limbata* Guérin-Méneville, 1831, p. 255
- interrupta* Banks, 1946, p. 353, ♀, [*Nannopepsis*], Brazil
- iolanthe* Banks, 1946, p. 330, ♀, [*Trichoepsis*], Colombia
- ismare* Banks, 1946, p. 331, ♀, [*Trichoepsis*], Ecuador
- itapaca* Banks, 1946, p. 387, ♂ ♀, Brazil
- itinerata* Brèthes, 1908, p. 241, ♀, Argentina
- janira* Brèthes, 1908, p. 237, ♀, Argentina
- jörgenseni* Brèthes, 1914, p. 326, ♀, [*Nannopepsis*], Bolivia, Argentina
- jucunda* Mocsáry, 1885, p. 249, ♀, Mexico, Colombia, Trinidad, Venezuela, British Guiana, Surinam, Brazil
- jujuyensis* Brèthes, 1908, p. 234, ♂, Bolivia, Argentina
- juno* Brèthes, 1908, p. 236, ♂, Paraguay
- karschi* Lucas, 1895, p. 706, ♀, Brazil, Paraguay
- kohli* Lucas, 1895, p. 690, ♂ ♀, Brazil
- körberi* Lucas, 1919, p. 82, ♀, Brazil
- laconia* Banks, 1946, p. 361, ♀, [*Cirripepsis*], Peru
- laetabilis* Brèthes, 1908, p. 241, ♂, Paraguay
- lahillei* Brèthes, 1908, p. 238, ♂, Argentina
- lampas* Lucas, 1895, p. 752, ♂ ♀, = *nitida* Lepeletier, 1845, p. 476
- lara* Mocsáry, 1889, p. 162, ♀, Brazil
- lassonis* Lucas, 1919, p. 121, ♂ ♀, variety of *nitida* Lepeletier, 1845, p. 476
- lativalvis* Mocsáry, 1894, p. 12, ♂, Panama
- lepida* Mocsáry, 1894, p. 9, ♂ ♀, Panama
- lestes* Lucas, 1895, p. 691, ♀, Brazil
- leucobasis* Smith, 1855, p. 193, ♂ ♀ = *equestris* Klug, 1848, p. 588
- lilloi* Brèthes, 1908, p. 241, ♀, Argentina
- limbata* Guérin-Méneville, 1831, p. 255, ♂ ♀, [*Trichoepsis*], Brazil, Peru, Bolivia, Chile,

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limbatella Brèthes, 1908, p. 242, ♂, Argentina
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longula Banks, 1946, p. 367, ♀, [*Stenopepsis*], French Guiana
lucasi Fox, 1898, p. 145, ♂ ♀, subspecies of *chrysothemis* Lucas, 1895, p. 739
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lurida Lucas, 1895, p. 804, ♂ ♀, [*Trichoepsis*], Brazil, Chile, Paraguay, Argentina
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lycaon Banks, 1945, p. 86, ♀, variety of *equestris* Klug, 1848, p. 588
lycaste Banks, 1946, p. 341, ♀, [*Deropepsis*], Bolivia
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meridionalis Brèthes, 1914, p. 340, ♂, Argentina
messerschmidtii Lucas, 1895, p. 558, ♀, Mexico
mexicana Lucas, 1895, p. 566, ♂ ♀, United States, Mexico, El Salvador, Nicaragua, Colombia
micans Mocsáry, 1885, p. 249, ♀, Colombia
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militaris Brèthes, 1914, p. 343, ♀, Brazil
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- pallidolimbata Lucas, 1895, p. 745, ♂ ♀, United States, Mexico
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- pan Mocsáry, 1885, p. 240, ♂, Brazil
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- parca Lucas, 1919, p. 152, ♀, Brazil
- parthenope Mocsáry, 1885, p. 242, ♂ ♀, [*Stenopepsis*], Colombia, Brazil, Chile
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- persephone Schrottky, 1903, p. 41, ♂ ♀, [*Deropepsis*], Brazil, Paraguay
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- petitii Guérin-Ménéville, 1831, p. 255, ♂ ♀, [*Trichopepsis*], Ecuador, Peru
- pilosa Banks, 1946, p. 393, ♂, Venezuela
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- planifrons Lucas, 1895, p. 684, ♀, [*Cirripepsis*], Colombia, Brazil, Bolivia
- plutus Klug, 1848, p. 588, ♂ ♀, [*Gigantopepsis*], British Guiana, Brazil
- polita Brèthes, 1908, p. 243, ♂, [*Trichopepsis*], Brazil, Argentina
- postica Lucas, 1895, p. 840; MS name cited in synonymy; isoholotypic with *deuteroleuca* Smith, 1855, p. 196
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- pretiosa Dahlbom, 1844, p. 121, ♂ ♀, [*Stenopepsis*], Venezuela, British Guiana, Brazil
- prismatica Smith, 1855, p. 200, ♂, Mexico
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- pseudoformosa* Cockerell, 1898, p. 146, = *formosa* (Say), 1823, p. 76
- pubiventris Lucas, 1895, p. 677, ♂, Brazil
- pulchella Lepeletier, 1845, p. 491, ♂, French Guiana
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- pulchripennis Mocsáry, 1885, p. 243, ♀, Trinidad, Venezuela, Brazil, Bolivia, Argentina
- pulskyi Mocsáry, 1885, p. 261, ♀, Brazil
- purpurascens Smith, 1855, p. 194, ♀, Brazil
- purpurea Smith, 1873, p. 51, ♀, [*Cirripepsis*], British Guiana, Brazil
- purpureipes Packard, 1869, p. 61, ♀, [*Stenopepsis*], Brazil
- pygidialis Brèthes, 1908, p. 237, ♂, Brazil
- pyramus Lucas, 1895, p. 742, ♂ ♀, Mexico
- quadrata Lepeletier, 1845, p. 478, ♂, West Indies
- quichua Brèthes, 1908, p. 235, ♂ ♀, Argentina
- quitonensis Packard, 1869, p. 61, ♂ ♀, [*Trichopepsis*], Colombia, Ecuador, Peru
- reaumuri Dahlbom, 1845, p. 465, ♂ ♀, [*Deropepsis*], Brazil, Paraguay, Uruguay, Argentina, Chile
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- richteri Brèthes, 1908, p. 242, ♀, Argentina?
- riojaneirensis Lucas, 1919, p. 67, ♀, Brazil
- roberti Brèthes, 1908, p. 236, ♂, Argentina
- rubescens Lucas, 1895, p. 735, ♀, Ecuador?, Brazil
- rubra (Drury), 1773, p. 75, ♀, West Indies, Trinidad
- rubripennis* (Christ), 1791, p. 264, = *rubra* (Drury), 1773, p. 75
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- ruficornis* Lucas, 1897, p. 293, ♂, renamed *erythrocerca* Brèthes, 1914, p. 244
- sabina Mocsáry, 1885, p. 265, ♀, Venezuela
- sagana Mocsáry, 1894, p. 10, ♀, [*Cirripepsis*], Colombia, British Guiana, Brazil
- sagax Lucas, 1895, p. 681, ♀, Brazil
- salamandra* Lucas, 1895, p. 773; MS name cited in synonymy; isoholotypic with *lara* Mocsáry, 1889, p. 162
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- sanguigutta (Christ), 1791, p. 293, ♂, West Indies
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- sappho Brèthes, 1908, p. 236, ♂, Argentina
- satrapes Lucas, 1895, p. 506, ♂, Brazil
- sayi* Banks, 1926, p. 202, ♀, = *angustimarginata* Viereck, 1908, p. 389
- schlinkei Lucas, 1897, p. 293, ♀, [♂?], Brazil
- schrottkyi Brèthes, 1908, p. 239, ♂, Paraguay, Argentina
- sciron* Mocsáry, 1885, p. 250, ♀, = *elevata* Fabricius, 1805, p. 213
- seifferti Lucas, 1895, p. 561, ♂, Brazil
- seladonica Dahlbom, 1844, p. 120, ♂ ♀, British Guiana, Brazil, Bolivia
- selene Lucas, 1895, p. 670, ♀, Brazil
- selvatica (Brèthes), 1920, p. 49, ♀, [*Deropepsis*], Peru
- sepultrix Lucas, 1919, p. 86, ♀, Brazil
- sericans Lepeletier, 1845, p. 473, ♀, unknown
- sericata Cresson, 1872, p. 209, ♀, variety of *marginata* Palisot de Beauvois, 1809, p. 94

- sherillae* Hurd, 1948, p. 146, ♂, variety of *thisbe* Lucas, 1895, p. 744
sibylla Mocsáry, 1885, p. 258, ♀, = *quintonensis* Packard, 1869, p. 61
sickmanni Mocsáry, 1889, p. 163, ♀, [*Deropepsis*], Brazil, Paraguay
similis Lucas, 1895, p. 536, ♂ ♀, Colombia, Brazil
sinnis Lucas, 1895, p. 808, ♂, [*Deropepsis*], Brazil, Uruguay, Argentina
sirene Lucas, 1895, p. 603, ♀, Colombia
smaragdina Dahlbom, 1844, p. 120, ♂ ♀, Brazil
smaragdina ab. *basifulgens* Lucas, 1919, p. 78
smaragdina ab. *nebulosipennis* Lucas, 1919, p. 75
smaragdina ab. *purpurea* Lucas, 1919, p. 79
smaragdinula Lucas, 1895, p. 672, ♂, Brazil, Paraguay
smithi Hurd, 1948, p. 142, ♂ ♀, subspecies of *pallidolimbata* Lucas, 1895, p. 745
solitaria Smith, 1879, p. 156, ♂, British Honduras, Costa Rica, Panama
somatochlora Hurd, 1950, p. 133, ♀, unknown
sommeri Dahlbom, 1845, p. 465, ♀, Mexico, Guatemala, Nicaragua, Ecuador
spathulifera Lucas, 1895, p. 503, ♂, Venezuela
speciosa (Fabricius), 1793, p. 217, ♂, = *rubra* (Drury), 1773, p. 75
speciosa Smith, 1855, p. 195, ♂, renamed *speciosissima* Schulz, 1906, p. 167
speciosissima Schulz, 1906, p. 167, ♂, [*Gigantopepsis*], Colombia, Brazil
spgazzinii Brèthes, 1908, p. 241, ♂, Argentina
spengeli Mocsáry, 1889, p. 162, ♂, = *cupripennis* Taschenberg, 1869, p. 28
sphinx Lucas, 1895, p. 610, ♂ ♀, Colombia, Trinidad, Surinam
splendens Lucas, 1895, p. 749; MS name cited in synonymy; isoholotypic with *reaumuri* Dahlbom, 1845, p. 465
staudingeri Enderlein, 1901, p. 145, ♂ ♀, [*Deropepsis*], Brazil, Argentina
stella Montet, 1921, p. 205, ♀, "Amérique tropicale"
stellata (Fabricius), 1793, p. 219, ♂, =? *sanguigutta* (Christ), 1791, p. 293
strenua Klug, 1848, p. 588, ♀, [*Stenopepsis*], Colombia, British Guiana
strickeri Lucas, 1919, p. 87, ♀, Brazil
stygia Lucas, 1895, p. 695, ♀, Brazil
sulcata Brèthes, 1908, p. 241, ♀, Paraguay
sulcifrons Cameron, 1903, p. 226, ♀, [*Stenopepsis*], Ecuador
sulphureicornis Palisot de Beauvois, 1809, p. 95, West Indies
sumptuosa Smith, 1855, p. 197, ♂ ♀, [*Gigantopepsis*], Colombia, Brazil
tandilensis Brèthes, 1914, p. 338, ♀, Argentina
taschenbergi Lucas, 1895, p. 675, ♂, Brazil
terebrans Brèthes, 1908, p. 243, ♂, Bolivia, Argentina
terminata Dahlbom, 1844, p. 120, ♂ ♀, Mexico, West Indies, Surinam, Brazil
thalassina Klug, 1848, p. 588, ♂, = *festiva* Fabricius, 1805, p. 214
thalia Brèthes, 1908, p. 233, ♂, [*Stenopepsis*], Peru, Paraguay
theresia Kriechbaumer, 1900, p. 98, ♂ ♀, [*Dinopepsis*], Trinidad, Colombia, Ecuador
thisbe Lucas, 1895, p. 744, ♂ ♀, United States, Mexico
thoreyi Dahlbom, 1845, p. 465, ♀, = *limbata* Guérin-Méneville, 1831, p. 255
thracis Brèthes, 1914, p. 271, ♀, Brazil
thunbergi Dahlbom, 1844, p. 121, ♂, = *viridisetosa* Spinola, 1841, p. 104
tinctipennis Smith, 1873, p. 50, ♀, Brazil, British Guiana
tolteca Lucas, 1895, p. 747, ♂, = *petitii* Guérin-Méneville, 1831, p. 255
toppini Turner, 1915, p. 413, ♀, [*Gigantopepsis*], Ecuador, Peru
tornowii Brèthes, 1908, p. 238, ♂, Argentina
transversa Brèthes, 1908, p. 235, ♀, Brazil, Argentina
tricolor Brèthes, 1914, p. 276, ♂, Argentina
tricuspidata Gribodo, 1896, p. 2, ♂, Panama
troglydites Brèthes, 1908, p. 243, ♂, Argentina
vaga Brèthes, 1908, p. 242, ♂, Argentina?
vagabunda Lepeletier, 1845, p. 484, ♀, unknown
varipennis Lepeletier, 1845, p. 488, ♂ ♀, Brazil, Argentina
vau-alba Smith, 1855, p. 195, ♂ ♀, Brazil, Bolivia
venezolana Brèthes, 1908, p. 235, ♂, variety of *deuteroleuca* Smith, 1855, p. 196
venezuelae Kay, 1913, pl. 1, fig. 13a, ♀, Venezuela
venosa Banks, 1945, p. 85, ♀, [*Stenopepsis*], Surinam, French Guiana
venturii Schrottky, 1902, p. 309, ♂, = *nitida* Lepeletier, 1845, p. 476
venusta Smith, 1855, p. 196, ♂, [*Stenopepsis*], United States, Mexico, Guatemala, Honduras, Costa Rica, Ecuador, Brazil
vicina Lucas, 1895, p. 836, ♀, [*Cirripepsis*], Venezuela, British Guiana, Surinam
victrix Lucas, 1895, p. 614, ♀, Argentina
villosa Brèthes, 1908, p. 238, ♀, [*Cirripepsis*], Brazil
vinciens Lucas, 1919, p. 88, ♀, Bolivia
vinipennis Packard, 1869, p. 61, ♀, [*Deropepsis*], Brazil, Peru
violacea Mocsáry, 1885, p. 255, ♂, America
meridionalis
violaceipennis Mocsáry, 1885, p. 253, ♂, Brazil, Peru
virescens Lepeletier, 1845, p. 484, ♂, Brazil
virgo Brèthes, 1908, p. 233, ♂, Argentina

viridis Lepeletier, 1845, p. 485, ♂, Brazil
 viridisetosa Spinola, 1841, p. 104, ♂, Brazil, Peru
 vitripennis Smith, 1855, p. 197, ♂ ♀, Costa Rica,
 Panama, Colombia, Brazil
 vittigera Lucas, 1897, p. 295, ♀, Brazil
 vivida Brèthes, 1908, p. 236, ♂, Paraguay

weberi Banks, 1946, p. 394, ♂, Trinidad
 xanthocera Dahlbom, 1844, p. 120, ♀, [*Deropepsis*
and Trichopepsis], Colombia, Trinidad, British
 Guiana, Surinam, French Guiana, Brazil,
 Ecuador, Peru, Bolivia
 zelotarum Lucas, 1919, p. 69, ♀, Brazil

NAMES FORMERLY APPLIED IN *PEPSIS*

abbreviata (Fabricius), 1805, p. 204
 albifrons (Fabricius), 1793, p. 207
 amethystina (Fabricius), 1793, p. 210
 arenaria (Fabricius), 1787, p. 272
 argentata (Fabricius), 1787, p. 275
 atrox (Drury), 1782, p. 57
 bonariensis Lepeletier, 1845, p. 476
 castanea Palisot de Beauvois, 1809, p. 95
 cincta (Fabricius), 1793, p. 205
 coerulea (Linnaeus), 1758, p. 571
 coerulea (Fabricius), 1775, p. 352
 coeruleans (Drury), 1773, p. 74
 crucis Fabricius, 1805, p. 209
 cyanea (Fabricius), 1775, p. 346
 cyanipennis (Fabricius), 1793, p. 200
 dahlbomi Stål, 1857, p. 64
 dedjaz (Guérin-Ménéville), 1849, p. 355
 diselene Smith, 1855, p. 200
 femorata (Fabricius), 1781, p. 443
 ferruginipennis (Haliday), 1837, p. 326
 fervens (Fabricius), 1775, p. 347
 flavicornis (Fabricius), 1781, p. 450
 flavipennis (Fabricius), 1793, p. 200
 fuscipennis Fabricius, 1805, p. 210
 gigas Fabricius, 1805, p. 213
 haemorrhoidalis (Fabricius), 1781, p. 443
 hirtipes (Fabricius), 1793, p. 207
 ichneumoneus (Guérin-Ménéville), 1831, p. 258

johannis Fabricius, 1805, p. 208
 lepeletieri Guérin-Ménéville, 1831, p. 257
 lusca Fabricius, 1805, p. 215
 lutaria (Fabricius), 1787, p. 273
 luteipennis Fabricius, 1805, p. 210
 macula Fabricius, 1805, p. 210
 maxillaris Palisot de Beauvois, 1806, p. 38
 maxillosa (Fabricius), 1793, p. 208
 nigrita (Fabricius), 1781, p. 449
 obscura Fabricius, 1805, p. 213
 ocellata (Fabricius), 1781, p. 450
 pennsylvanica (Linnaeus), 1763, p. 30
 pictipennis Mocsáry, 1894, p. 4
 plumbea (Fabricius), 1787, p. 278
 pubescens (Fabricius), 1793, p. 205
 4-punctata (Fabricius), 1787, p. 278
 ruficeps Lepeletier, 1845, p. 489
 rufipennis (Fabricius), 1793, p. 200
 rufipes Lepeletier, 1845, p. 473
 sericea Fabricius, 1805, p. 211
 serricornis Fabricius, 1805, p. 215
 severa (Drury), 1782, p. 58
 T[au] Palisot de Beauvois, 1812, p. 117
 thomae (Fabricius), 1775, p. 346
 tibialis (Fabricius), 1781, p. 444
 tomentosa (Fabricius), 1787, p. 274
 unifasciata Radoszkowski, 1881, p. 214
 violacea (Fabricius), 1775, p. 346

NAMES CURRENTLY APPLIED TO THE SUBGENERA OF *PEPSIS*

SUBGENUS *BRETHESIA* SCHROTTKY

Brethesia SCHROTTKY, 1909, Ann. Soc. Cient.
 Argentina, vol. 68, p. 243.

TYPE: *Pepsis dimidiata* Fabr[icius], 1805,
 p. 216], by original designation.

The name *Brethesia* was proposed by
 Schrottky (1909, p. 243) as a new name for
Pepsis Fabricius (1805, p. 207) under the
 impression that the type of the latter was
Sphex arenaria Fabricius (1787, p. 272).
 However, as Pate (1946, p. 78) has indicated,
 neither the position taken by Schrottky nor
 that expressed by Malaise (1937) with regard
 to the supposed type designations of Fabri-

cus has any status under the present Rules
 of Zoological Nomenclature.

Schrottky included three species in
Brethesia, viz., *dimidiata* Fabricius (1805, p.
 216), *limbata* Guérin-Ménéville (1831, p. 255),
 and *chrysoptera* Burmeister (1872, p. 233).
 Banks (1945, p. 82) designated *limbata* as
 the type of his subgenus *Trichopepsis* and
 in 1946 indicated that *chrysoptera* belongs in
Pepsis, *sensu stricto*.

NAMES CURRENTLY APPLIED IN *Brethesia*
dimidiata Fabricius, 1805, p. 216

SUBGENUS *CIRRIPEPSIS* BANKS

Cirripepsis BANKS, 1945, Bol. Ent. Venezolana,
 vol. 4, p. 82.

TYPE: *Pepsis planifrons* Lucas [1895, p. 684], by original designation.

Banks (1945, p. 82) erected the subgenus *Cirripepsis* with *Pepsis planifrons* Lucas [1895, p. 684] as its designated type. Banks (1946, p. 353) using the same name and the same type proposed the subgenus anew, and hence *Cirripepsis* Banks (1946, p. 353) is primarily homonymic and isogenotypic with *Cirripepsis* Banks (1945, p. 82).

NAMES CURRENTLY APPLIED IN *Cirripepsis*

andina Brèthes, 1908, p. 234
astioles Banks, 1946, p. 355
aurimacula Mocsáry, 1885, p. 262
guttata Lucas, 1895, p. 532
hirtiventris Banks, 1946, p. 357
ilione Banks, 1946, p. 358
laconia Banks, 1946, p. 361
moesta Banks, 1946, p. 358
orestes Banks, 1946, p. 359
planifrons Lucas, 1895, p. 684
purpurea Smith, 1873, p. 51
sagana Mocsáry, 1894, p. 10
vicina Lucas, 1895, p. 836
villosa Brèthes, 1908, p. 238.

SUBGENUS *DEROPEPSIS* BANKS

Deropepsis BANKS, 1946, Bull. Mus. Comp. Zool., Harvard Coll., vol. 96, pp. 336-337.

TYPE: *Pepsis frivaldszkyi* Erichson (= *Pepsis frivaldszkyi* Mocsáry, 1885, p. 259), by original designation.

This subgenus was proposed by Banks (1946, pp. 336-337) with the type stated to be *Pepsis frivaldszkyi* Erichson. However, reference to Kl[ug] (*in* Erichson *in* Schomburgk, 1848) reveals that no such name, and hence species, was treated. It would appear that the intended genotype is *Pepsis frivaldszkyi* Mocsáry (1885, p. 259), since no mention of the name *frivaldszkyi* in the genus *Pepsis* appears until that date.

NAMES CURRENTLY APPLIED IN *Deropepsis*

assimilis Banks, 1946, p. 343
atrata Lepeletier, 1845, p. 470
comes Banks, 1946, p. 342
cupripennis Taschenberg, 1869, p. 28
defecta Taschenberg, 1869, p. 30
deuteroleuca Smith, 1855, p. 196
discolor Taschenberg, 1869, p. 28
diversipennis Mocsáry, 1885, p. 261
elevata Fabricius, 1805, p. 213

erythroptera Mocsáry, 1885, p. 244
euterpe Brèthes, 1908, p. 242
flaminia Brèthes, 1914, p. 332
frivaldszkyi Mocsáry, 1885, p. 259
glabripennis Lucas, 1895, p. 613
guaranitica Brèthes, 1908, p. 239
hecuba Mocsáry, 1885, p. 252 (also cf. *Trichopepsis*)
heros (Fabricius), 1798, p. 245
hyperion Mocsáry, 1894, p. 11
lampas Lucas, 1895, p. 752
lassonis Lucas, 1919, p. 121
lycaste Banks, 1946, p. 341
nitida Lepeletier, 1845, p. 476
nutrix Brèthes, 1914, p. 337
persephone Schrottky, 1903, p. 41
postica Lucas, 1895, p. 840
reaumuri Dahlbom, 1845, p. 465
sciron Mocsáry, 1885, p. 250
selvatica (Brèthes), 1920, p. 49
sickmanni Mocsáry, 1889, p. 163
sinnis Lucas, 1895, p. 808
spengeli Mocsáry, 1889, p. 162
splendens Lucas, 1895, p. 749
staudingeri Enderlein, 1901, p. 145
venezolana Brèthes, 1908, p. 235
venturii Schrottky, 1902, p. 309
vinipennis Packard, 1869, p. 61
xanthocera Dahlbom, 1844, p. 120 (also cf. *Trichopepsis*)

SUBGENUS *DINOPEPSIS* BANKS

Dinopepsis BANKS, 1945, Bol. Ent. Venezolana, vol. 4, p. 83; 1946, Bull. Mus. Comp. Zool., Harvard Coll., vol. 96, p. 334.

TYPE: *Pepsis grossa* Fabr[icius], i.e., *Sphex grossa* Fabricius, 1798, p. 245], by original designation.

NAMES CURRENTLY APPLIED IN *Dinopepsis*

grossa (Fabricius), 1798, p. 245
inclyta Lepeletier, 1845, p. 475
prudentialpolitana Lucas, 1919, p. 99
theresia Kriechbaumer, 1900, p. 98

SUBGENUS *GIGANTOPEPSIS* LUCAS

Gigantopepsis LUCAS, 1919, Arch. Naturgesch., div. A, vol. 83, no. 5, pp. 10, 41. BANKS, 1945, Bol. Ent. Venezolana, vol. 4, pp. 81-82; 1946, Bull. Mus. Comp. Zool., Harvard Coll., vol. 96, p. 317.
Gigantopepsis PATE, 1946, Trans. Amer. Ent. Soc., vol. 72, p. 88 (*lapsus* or emendation for *Gigantopepsis* Lucas, 1919, pp. 10, 41).

TYPE: *Pepsis gigantea* R. Luc[as, 1895 p. 575], by original designation.

NAMES CURRENTLY APPLIED IN *Gigantopepsis*

alcimeda Banks, 1946, p. 318
altitarsus Enderlein, 1901, p. 147
 amalthea Banks, 1946, p. 319
 astarte Banks, 1945, p. 87
 aurifex Smith, 1855, p. 191
 aurozonata Smith, 1855, p. 191
chrysochlamys Mocsáry, 1894, p. 2
 cleanthes Banks, 1946, p. 320
 eubule Banks, 1946, p. 321
eximia Smith, 1873, p. 49
 gigantea Lucas, 1895, p. 575
 hyperion Mocsáry, 1894, p. 11 (also cf. *Deropepsis*)
 optima Smith, 1879, p. 157
 plutus Klug, 1848, p. 588
speciosa Smith, 1855, p. 195
 speciosissima Schulz, 1906, p. 167
 sumptuosa Smith, 1855, p. 197
 toppini Turner, 1915, p. 413

SUBGENUS NANNOPEPSIS BANKS

Nannopepsis BANKS, 1945, Bol. Ent. Venezolana, vol. 4, p. 82.

TYPE: *Pepsis pruinosa* Lucas [1895, p. 753], by original designation.

This subgenus was first proposed by Banks (1945, p. 82) with *Pepsis pruinosa* Lucas [1895, p. 753] designated as its type. Later, Banks (1946, p. 351) appears to have proposed anew the subgenus *Nannopepsis* and designated *Pepsis pruinosa* Mocsáry, 1894, p. 5] as its type. Since Banks has clearly indicated in each proposal that the subgenus being characterized is new and that the names thereto applied as genotypic designations are assigned to a different author in each proposal, the problem resolves itself into one of species interpretation. Hence, if it is shown that the species characterized by Lucas (1895, p. 753) is not conspecific with that of Mocsáry (1894, p. 5), then the two different proposals of *Nannopepsis* (1945, 1946) will necessitate nomenclatorial rectification. However, if the two species interpretations coincide, then the two subgeneric proposals should be regarded as synonymous as well as homonymous.

NAMES CURRENTLY APPLIED IN *Nannopepsis*

aretheas Brèthes, 1914, p. 331
 concava Brèthes, 1908, p. 239
 consors Banks, 1946, p. 352
 cordata Brèthes, 1914, p. 272
 dorsata Brèthes, 1914, p. 329

interrupta Banks, 1946, p. 353
 jörgenseni Brèthes, 1914, p. 326
 pampeana Brèthes, 1908, p. 240
 pruinosa Mocsáry, 1894, p. 5
 pruinosa, Lucas, 1895, p. 753

SUBGENUS STENOPEPSIS BANKS

Stenopepsis BANKS, 1945, Bol. Ent. Venezolana, vol. 4, p. 82; 1946, Bull. Mus. Comp. Zool., Harvard Coll., vol. 96, p. 362.

TYPE: *Pepsis hymenaea* Mocs[áry, 1885, p. 257], by original designation.

NAMES CURRENTLY APPLIED IN *Stenopepsis*

aen(e)ipennis Banks, 1946, p. 372
 albolimbata Mocsáry, 1885, p. 250
 alector Banks, 1946, p. 371
 amyntas Mocsáry, 1885, p. 241
apicalis Gray, 1832, p. 516
 australis Saussure, 1868, p. 65
bicolor Lepeletier, 1845, p. 488
 citreicornis Mocsáry, 1894, p. 11
 cofanes Banks, 1946, p. 364
 consimilis Banks, 1946, p. 369
 cyanosoma Lucas, 1895, p. 557
 cybele Banks, 1945, p. 84
 egregia Mocsáry, 1885, p. 246
 elongata Lepeletier, 1845, p. 482
 erdmanni Lucas, 1895, p. 516
 festiva Fabricius, 1805, p. 214
 flavescens Lucas, 1895, p. 511
 flavilis Brèthes, 1908, p. 235
 gracilis Lepeletier, 1845, p. 474
 hyalinipennis Mocsáry, 1885, p. 240
 hymenaea Mocsáry, 1885, p. 257
 ierensis Banks, 1945, p. 83
 incerta Banks, 1946, p. 369
 insignis Mocsáry, 1885, p. 248
 longula Banks, 1946, p. 367
 mystica Lucas, 1895, p. 682
 optimatis Smith, 1873, p. 50
 parthenope Mocsáry, 1885, p. 242
 pretiosa Dahlbom, 1844, p. 121
 purpureipes Packard, 1869, p. 61
 strenua Klug, 1848, p. 588
 sulcifrons Cameron, 1903, p. 266
 thalia Brèthes, 1908, p. 233
thalassina Klug, 1848, p. 588
 venosa Banks, 1945, p. 85
 venusta Smith, 1855, p. 196

SUBGENUS TRICHOPEPSIS BANKS

Trichopepsis BANKS, 1945, Bol. Ent. Venezolana, vol. 4, p. 82; 1946, Bull. Mus. Comp. Zool., Harvard Coll., vol. 96, p. 323.

TYPE: *Pepsis limbata* Guér[in-Méneville, 1831, p. 255], by original designation.

NAMES CURRENTLY APPLIED IN *Trichopepsis*

- aciculata* Taschenberg, 1869, p. 29
andicola Cameron, 1903, p. 226
atahualpa Banks, 1946, p. 328
cassiope Mocsáry, 1889, p. 161
chilloensis Cameron, 1903, p. 227
circe Mocsáry, 1885, p. 263
elisa Montet, 1921, p. 208
fasciculata Brèthes, 1908, p. 243
fulvipennis Le Guillou, 1841, p. 319
hecuba Mocsáry, 1885, p. 252 (also cf. *Deropepsis*)
huascar Banks, 1946, p. 327
intermedia Schrottky, 1902, p. 314
iolanthe Banks, 1946, p. 330
ismare Banks, 1946, p. 331
limbata Guérin-Méneville, 1831, p. 255
lurida Lucas, 1895, p. 804
nessus Lucas, 1895, p. 787
nigricans Lucas, 1895, p. 806
patagonica Brèthes, 1908, p. 241
peruana Lucas, 1895, p. 595
petitii Guérin-Méneville, 1831, p. 255
polita Brèthes, 1908, p. 243
quitonensis Packard, 1869, p. 61
sibylla Mocsáry, 1885, p. 258
thoreyi Dahlbom, 1845, p. 465
tolteca Lucas, 1895, p. 747
xanthocera Dahlbom, 1844, p. 120 (also cf. *Deropepsis*)

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