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A NEW PSEUDOMASARIS FROM CALIFORNIA, WITH SOME CONSIDERATIONS ON THE MASARID WASPS (HYMENOPTERA)

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While in Southern California, last spring, Professor W. M. Wheeler collected a large number of masarid wasps belonging to two species, one of which appears to be new. I have used the opportunity offered by the description of this insect, to present a few remarks of a more general nature on the Masaridinae, by far the most interesting subfamily of diplopterous wasps. As I hope to show, their structure, habits and distribution exhibit a number of remarkable features that render the group worthy of consideration by the biologist.

***Pseudomasaris (Pseudomasaris) wheeleri*, new species** (Fig. 1)

A large, minutely sculptured, dull species; black, with numerous and rather variable sulphur-yellow markings, the mesonotum with two complete or interrupted longitudinal stripes, the abdomen often with a *Vespa*-pattern.

Length (h. + th. + t. 1 + 2): ♂, 10 to 10.5 mm.; ♀, 9 to 12 mm. (total length, approximately 13 to 17 mm.); of wing ♂, 12.5 mm. and ♀, 11 to 12.5 mm.

MALE.—Head broadly elliptical in front view, about one and one-fifth times as wide as high; seen from above, about twice as wide as long, much narrower than the thorax. Oc-

cipital margin of vertex far from the eyes, with a distinct inward curve, margined by a blunt carina which does not continue on the cheeks. Cheeks narrow, though distinct, about one-fourth the width of the eye in profile, gradually narrowed toward the vertex and evenly rounded in the lower half. Oculo-malar space short, but distinct, a little over one-fourth as long as the width of the mandibular articulation. Eyes more bulging than usual in the subgenus *Pseudomasaris*, proper. Inner orbits more than three times as far apart at the clypeus as on the vertex, where the eyes are separated by about three times the diameter of a posterior ocellus. Frons flat, not carinate, very faintly raised between the insertions of the antennae, with the merest trace of a median tubercle in the center, shallowly concave below the anterior ocellus. Ocular sinus deep, bluntly rounded at apex. Ocelli large, in a flattened triangle; the anterior ocellus much larger than the others, subcircular; posterior ocelli about twice as far apart as their diameter, barely separated from the inner orbits, distant from an imaginary line connecting the posterior borders of the eyes by a little over twice their distance from each other. Interocellar area flat. Vertex strongly sloping posteriorly, slightly concave in front view. Antennae about four times as far apart as they are removed from the inner orbits. Clypeus strongly and evenly convex throughout, in outline flattened hexagonal with rounded upper angles, nearly one and one-half times as wide as long; the anterior, free portion about one-fourth shorter than the basal, interocular part; the upper margin slightly convex; the upper lateral margins slightly oblique, very broadly separated from the eyes, the intervening space wider than the length of the oculo-malar space; the lower lateral margins slightly concave, forming almost right angles with the upper lateral margins; the truncate apex a little over half the maximum width of the clypeus, deeply, arcuately emarginate; the apical angles very broadly rounded, with a translucent border. Antenna of 12 segments, very long, shaped much as in *P. occidentalis*, but the third to seventh segments more slender than in that species; the third to sixth not at all enlarged at their apices; the seventh slightly and evenly widened toward the apex, where

it is less than half as wide as long; the terminal club of five very superficially separated segments, seen from above regularly short oval, sharply set off, much wider than thick, a little over one-half as wide as long, slightly longer than the sixth and seventh segments together, somewhat flattened dorsally, more convex ventrally where there is a slight

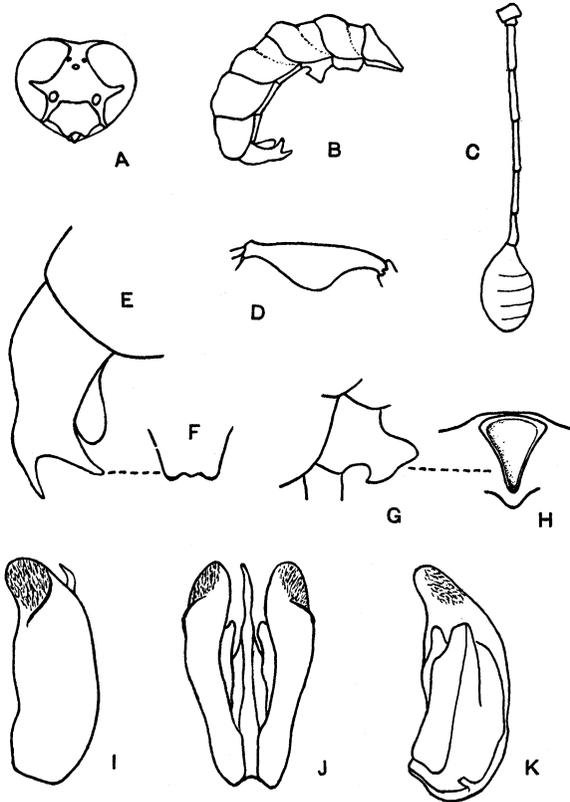


Fig. 1. *Pseudomasaris wheeleri* J. Bequaert. Male: A, head in front view; B, abdomen in profile; C, left antenna from above; D, right middle tibia in front view; E, seventh tergite in profile; F, apical margin of seventh tergite in dorsal view; G, third sternite in profile; H, apex of process of third sternite in ventral view; I, right side of genitalia in profile, showing external view of valva externa (squama of Bradley); J, genitalia in dorsal view; K, internal view of left valva externa (Bradley's squama), showing valva interna (Bradley's sagitta and volsella).

transverse depression close to the base. Mandibles folded beneath the labrum, smooth on the outer surface, ending in a long, finger-shaped, blunt apex, the inner margin with two faint denticulations before the apex. Thorax elongate rectangular, about one and one-fourth times as long as its greatest width, distinctly narrowed anteriorly and very slightly posteriorly, much lower than wide. Anterior margin of pronotum almost straight, rounded off, without carina or rim, slightly depressed in the middle; humeral angles slightly raised into blunt, broadly rounded humps. Mesonotum distinctly longer than wide, almost hexagonal in outline, the anterior margin forming a very low outward curve; slightly and uniformly convex in its anterior half, flattened in its posterior half; without traces of parapsidal furrows, but with a fine, incomplete furrow on each side in the posterior half (above the tegula) and a fine, median somewhat raised line in the anterior half. Tegula about two and one-half times as long as wide; the outer margin shallowly notched before the middle; the apex covering the base of the scutellum on the side. Scutellum very large, semi-elliptical, with a broadly rounded apical margin which does not entirely cover the postscutellum in a dorsal view; evenly convex throughout, with a very low, blunt, somewhat elongate, median tubercle close to the anterior margin; mesonotal suture not foveolate. Postscutellum very short; its median portion semi-elliptical from behind, divided into a very short, slightly swollen, anterior, horizontal portion (visible behind the scutellum from above) and a much longer, vertical, posterior area (in a plane with the concavity of the propodeum). Mesepisternum divided from the epimeron, but without a suture between the upper and the lower plates, without prepectal carina or suture and not depressed anteriorly into epicnemial for the front legs; the usual impressed line marking the sternopleural suture, distinct. Propodeum short, squarely and vertically truncate behind, very slightly convex on the sides from above; dorsal areas broadly separated from each other by the postscutellum, sloping gradually into the concavity (superior ridges not developed); lateral ridges blunt; inferior ridges carinate, sharp; concavity wide, very shallow, with a deeper median

depression which is divided by a low, blunt, longitudinal ridge starting behind the postscutellum and not reaching the abdominal articulation; lateral angle produced into a straight, broadly triangular, blunt, flattened tooth, directed posteriorly; the tooth continuous with the lateral ridge but set off rather sharply from the inferior ridge. Abdomen much elongate, of the shape usual in males of *Pseudomasaris*; the second, third and fourth tergites strongly constricted and depressed at the base. Armature of seventh tergite much as in *P. occidentalis*, but the preapical pair of tubercles longer and more finger-shaped, with a sharp carina at the base dorsally (in some specimens this carina is slightly more raised basad, behind a transverse depression of the tergite, on the spot where the fifth or sixth tubercle is situated in *P. vespoides*); the tubercles of the apical pair are also narrower than in *P. occidentalis* and are separated by a slight median projection of the hind margin. Second sternite slightly raised anteriorly, where there is a median notch separating two low tubercles (much less pronounced than in *P. occidentalis* and not continued posteriorly into blunt, oblique ridges as in that species). Process of third sternite in profile rather low and broad; its truncate summit forming an almost equilateral triangle, with a broad, shallow depression; its anterior angles bluntly rounded, without teeth; its posterior angle forming a short, but rather sharp tooth directed posteriorly (in general shape the process is more like that of *P. vespoides* than like that of *P. occidentalis*). Legs long and stout. Front femur and tibia slightly flattened beneath, their surfaces regular; the tibia slightly swollen; all the segments of the front tarsus ciliate along the outer margin. Middle femur regular, slightly flattened beneath where the posterior margin shows a faint indication of a notch before the base; middle tibia in front view strongly widened on the inferior edge, the dilatation semi-elliptical in outline, broadly rounded off, placed about the middle of the length of the tibia, slightly flattened on the inner side. Hind femur and tibia regular; the tibia gradually and moderately widened toward the apical half; hind basitarsus regular, slender, straight, not appreciably flattened. Middle tibia with one apical spur; larger spur of hind

tibia bifid at apex. Tarsal claws simple. Wings with the usual venation of *Pseudomasaris*; radial cell rather long and narrow; second cubital rather large, its length on the radius variable, often as long as the distance between the ends of the two recurrent veins on the cubitus; second intercubitus strongly bent below the middle. Genitalia (Fig. 1 I-K) essentially as in *P. occidentalis*.

Body mostly dull, densely and fairly uniformly covered with medium-sized and smaller punctures (visible with a hand-lens). Center of the frons more coarsely punctured. On mesonotum and scutellum the punctures are of two sizes, the larger ones especially numerous over the posterior portion of the mesonotum. Puncturation stronger on the basal constricted areas of the first three tergites than on the remainder of the abdomen. The following parts are impunctate and shiny: most of the outer surface of the mandible; the median depressed area of the concavity of the propodeum; a median, more or less triangular area at the base of the second to sixth tergites; and the middle of the seventh tergite very extensively at the base. Pubescence short, but rather abundant on head and thorax, sparser on the abdomen; mostly grayish, a little darker on mesonotum and vertex. Posterior edge of middle femur with dense, somewhat silvery brown pile on the under side.

Black, with the following areas sulphur-yellow: mandibles (except the long black apices); labrum (except the ferruginous tip); clypeus (except the upper margin very narrowly and minute dots in the center); a double spot on the frons above the insertions of the antennæ; the inner orbits from the base of the mandibles to the posterior ocelli, filling the ocular sinuses and widening on the frons to connect with the median spots; a small spot above each of the posterior ocelli; outer orbits, the yellow not reaching the vertex; most of the pronotum (except for a black, more or less triangular spot in the posterior half); a large spot in the upper part of the mesepisternum; tegulæ; a spot on each side of the mesonotum close to the hind portion of the tegula; four elongate spots over the middle of the mesonotum (forming two interrupted, diverging stripes); broad hind margin and extreme sides of scutellum; extreme sides

(lateral angles and ventral areas) of propodeum; broad apical bands on all tergites, those on the first to fourth very wide on the sides and abruptly narrowed, the median anterior margin wavy; all the sternites (except for the bases and the apical depressed area of the process of the third sternite); and most of the legs (front coxæ, trochanters and femora partly black above; middle and hind coxæ and trochanters black beneath; under side of middle and hind femora with a narrow black line; tarsi partly ferruginous). On the fifth abdominal tergite the yellow is very extensive and partly divided in the middle by a sharp projection from the black base, while there is a free, ovate, black spot on each side in the yellow; the yellow band of the sixth tergite is similar to that of the fifth, but there are no free black spots; the four tubercles of the seventh tergite are black and the two of each side are connected by a narrow black line. Antenna ferruginous to black; scape with a yellow apical band; third segment extensively yellow above; the fourth to sixth with some yellow streaks on the upper side; the club spotted with yellow at the base both above and beneath. Wings subhyaline, very slightly suffused with ferruginous brown in the costal, radial and first cubital cells and along some of the veins; the veins reddish brown, the stigma bright fulvous. The variations of the color in the males are slight: sometimes the frontal spots are much reduced or even lacking; the anterior margin of the postscutellum may be yellow in the middle; or the concavity of the propodeum may show two or three small yellow spots; the apical fasciæ of the first four tergites instead of being wavy, may be more angularly emarginate anteriorly.

FEMALE.—Agrees in most respects with the male, except as indicated below. Occipital margin almost straight. Eyes not bulging. Inner orbits distinctly, though very little farther apart at the clypeus than on the vertex. Frons entirely flat, without even a trace of median tubercle. Ocular sinus broader. Ocelli subequal, in a flattened triangle; the posterior ocelli a little closer to each other than to the eyes. Vertex flat, not sloping, without fovea. Antennæ about five times as far apart as they are from the inner orbits. Clypeus

relatively longer, about one and one-third times as wide as long; the apical, free portion a little less than half the length of the basal, interocular part. Antenna as in the female of *P. occidentalis*, of 12 segments; scape more elongate than in the male; second segment very small; third to sixth short, narrower than the remainder, which form an elongate-elliptical swollen club not abruptly set off at base; third segment slightly longer than the three following together. Mandible with a very broad, bluntly rounded apex and the merest indication of two preapical denticulations on the inner margin. Humeral angles very evenly rounded, not humped. The lateral angles of the propodeum sharper than in the male. Abdomen of the normal shape, without constrictions or processes; the second and third tergites slightly depressed transversely near the base. Legs normal.

Abdomen uniformly covered with minute punctures, without shiny areas at the bases of the tergites. Clypeus very coarsely punctate, the punctures even coarser than on the frons. Pilosity of the clypeus denser and longer than in the male.

Yellow markings more extensive and more variable than in the male. Tip of labrum, under side of antennal club and last segments of all tarsi partly ferruginous. The following areas are sulphur-yellow: mandible (except the broad black apex); most of labrum; clypeus (except for a median black mark in the form of a ring, a horse-shoe, or two half rings, sometimes reduced to four dots); inner orbits from mandibles to vertex, broader above the ocular sinuses, but separated from the frontal spot; a triangular spot on the frons, resting on the clypeus (sometimes reduced to two lines or to indefinite spots); outer orbits, not connected with the inner orbits; most of pronotum (a black stripe on each side, of variable width, often running from the anterior to the lateral margin, sometimes broken up in spots); most of mesopleura; tegulæ; four longitudinal stripes on the mesonotum, one above each tegula (sometimes much shortened) and two in the middle, diverging and somewhat hooked anteriorly (very rarely broken up); broad hind margin of scutellum; postscutellum (in one specimen mostly black);

most of the propodeum (sometimes with two or three black spots, rarely extensively black in the concavity) ; very broad apical margins to tergites one to five, variously marked with black as noted below; most of the sternites; and the legs (except for spots on the coxæ and occasional spots or streaks at the base of some or of all the femora). In an extreme yellow example, the dorsal surface of the abdomen is almost wholly yellow, only the bases of the tergites being black and emitting black projections into the yellow; on the first and second tergites these projections are median only; on the third, fourth and fifth there are three black notches, one in the middle and one on each side; on the sixth a black median line connects the base with the apex of the tergite. In the extreme black specimens, the apical margins are slightly narrower and in addition to the black notches there is a transverse black spot in the yellow on each side of the first three tergites; these spots may be free or connected with the lateral notches; sometimes they are barely indicated or present on the first tergite only.

Male, holotype, and female, allotype, in the Museum of Comparative Zoölogy, at Cambridge. Paratypes of both sexes will be deposited at the United States National Museum, the American Museum of Natural History, the Philadelphia Academy of Natural Sciences, the California Academy of Sciences, and the British Museum.

CALIFORNIA: Seven males (including the holotype) and fifty-four females (including the allotype), from Palm Springs, Riverside Co., collected by Professor W. M. Wheeler at flowers of Yerba Santa, *Eriodictyon tomentosum* Benth., in April 1928.

Although the eyes of the male are much more bulging than is customary in the subgenus *Pseudomasaris*, proper, with the posterior ocelli almost touching the eyes which are only separated by three times the diameter of a posterior ocellus, it is impossible to include *P. wheeleri* in the subgenus *Holopticus*, since the upper orbits are still far removed from the occipital margin. Moreover, the new species is very closely allied to *P. occidentalis* (Cresson), as shown

by a comparison of specimens.¹ Both species have practically the same peculiar structure of the legs in the male. Bradley (1922, Univ. of California Publ. Ent., I, No. 9, p. 424) writes of the male of *P. occidentalis*: "the middle tibia seen from in front with its inferior edge at the basal third strongly dilated and angulate." As a matter of fact, in that species the middle tibia is almost exactly as I describe and figure it for *P. wheeleri*. The two species are, nevertheless, readily separated in the males by the shape of the head (eyes not bulging in *P. occidentalis*, separated on the vertex by at least five times the diameter of a posterior ocellus, which is distinctly removed from the inner orbit), of the four tubercles of the seventh tergite (the preapical tubercles much shorter in *P. occidentalis* and not sharply carinate at the base), and of the process of the third sternite (in *P. occidentalis* the summit is very narrow, with a longitudinal groove which is abruptly widened anteriorly). The slight differences in the genitalia to be noted between my figures of *P. wheeleri* and those given by Bradley for *P. occidentalis* (1922, *Op. cit.*, Pl. X, figs. 62-64) are probably accidental and due to the method of preparation. On the other hand, the females of the two species are structurally so much alike, that after a very careful comparison I can only point out the following differences: in *P. occidentalis* the vertex is wider, the inner orbits being there about as far apart as at the clypeus and the posterior ocelli being also distinctly more removed from the inner orbits than from each other; the clypeus is decidedly longer, being but little wider than long. Of course the coloration of the two species is strikingly different in both sexes.

Incidentally it may be noted that the character used by Bradley in his working key (1922, *Op. cit.*, p. 381) to separate *Masaris* from *Pseudomasaris*, viz., postscutellum covered or not covered by the scutellum, is not very reliable. In *P. wheeleri* the postscutellum may distinctly be seen in a dorsal view, protruding beyond the apex of the scutellum, although this is more marked in the male than in the female.

¹I have been able to examine a pair of *P. occidentalis*, kindly loaned to me by the United States National Museum, through Miss Grace Sandhouse.

The true distinguishing features between the two genera are, however, correctly given by Bradley in his synoptic table of the genera (1922, *Op. cit.*, p. 389).

ADDITIONAL RECORDS OF PSEUDOMASARIS

The following records extend the known range of the genus and of some of the species. Some of the specimens belong to the collections of the Museum of Comparative Zoölogy at Cambridge (M. C. Z.).

1. *P. vespoides* (Cresson).—ARIZONA: Grand Canyon. 1 ♂ (G. P. Engelhardt). COLORADO: Cripple Creek Rd. (Corley Mt. Highway), Teller Co., 8,930 ft., at flowers of *Pentstemon glaber* Pursh, 3 ♀ and 1 ♂, July 1, 1928 (J. Bequaert) the females disappear entirely within the flowers; the males, however, were flying very swiftly from flower to flower in search of the females; it was noted that the smaller *Pentstemon confertus* Douglas, although much more abundant in that particular spot, did not attract any masarid. Plainview, Jefferson Co., 8 ♀ and 1 ♂, July 9 to 14, 1922 (G. P. Engelhardt). Boulder, 1 ♀ (M. C. Z.). Platte Canyon, 1 ♀ (M. C. Z.). Hall's Valley, 2 ♂, August. UTAH: Eureka, 1 ♂ (T. Spalding) (M. C. Z.). CALIFORNIA: Lakeside, 1 ♂ (E. P. Van Duzee) (M. C. Z.). Tallac, Eldorado Co., 6,000 ft., 1 ♀ (W. M. Giffard) (M. C. Z.).

2. *P. texanus* (Cresson).—TEXAS: Waco, 2 ♀ (M. C. Z.).

3. *P. zonalis* (Cresson).—COLORADO: Plainview, Jefferson Co., 4 ♀ and 1 ♂, July 9 to 14, 1922 (G. P. Engelhardt). CALIFORNIA: Alta Mesa, 1 ♀. WASHINGTON: Skagit Valley, 1 ♂ (M. C. Z.). BRITISH COLUMBIA: Princeton, 1,800 ft., 1 ♂ (M. C. Z.).

4. *P. edwardsii* (Cresson).—UTAH: Logan, 1 ♂ (E. S. G. Titus) (M. C. Z.). CALIFORNIA: Alpine, San Diego Co., 1 ♂ (E. P. Van Duzee) (M. C. Z.). Palm Springs, Riverside, Co., 8 ♀, at flowers of *Phacelia* sp., April 1928 (W. M. Wheeler).

5. *P. marginalis* (Cresson).—COLORADO: Granite Peaks Camp on the Pine River, near Bayfield, La Plata Co., 9,000

ft., 18 ♀, at flowers of *Phacelia heterophylla* Pursh, July 16 to 21, 1928 (J. Bequaert). These insects were active only during the warmest hours of the day and in bright sunshine. Most of the specimens were observed between 9 A. M. and 1 P. M. Although many other flowers were carefully watched for insect visitors and some species of *Pentstemon* were growing in that locality, *P. marginalis* was seen visiting only *Phacelia heterophylla*. No male was ever seen near the flowers.

CHARACTERS OF THE MASARIDINÆ

The subfamily Masaridinæ is one of the best-defined groups among the Vespidæ, or folded-winged wasps. It agrees with the other Diploptera in having the first discoidal cell (M^1) of the fore wing at least as long as the submedian ($Cu+Cu_1$), the only peculiar character that holds good throughout the entire family Vespidæ. Yet it should be observed that this peculiarity of the wing is not as strongly marked, as a rule, in the Masaridinæ as in most other subfamilies of Diploptera (with the exception of the Gayellinæ and Euparagiinæ). The lengthening of the first discoidal cell is evidently correlated with the longitudinal plaiting of the wing, a feature not or but faintly shown by most Masaridinæ. In this connection it is noteworthy that in the few masarid genera (*Quartinia* and *Celonites*) in which the fore wings are strongly plaited, the first discoidal cell is very long. The wing of *Celonites*, for instance, differs hardly in this respect from that of *Vespa*.

The one distinguishing character of all Masaridinæ, not found elsewhere among the Diploptera, is the simplified venation of the hind wing, in which the transverse median vein (M^3) is straight and not angulate, the discoidal vein ($m+M_2$) being apparently wanting. But, as shown by Bradley (1922, *Op. cit.*, p. 374), the position of the pre-axillary excision seems to warrant the conclusion that the apical section of the anal vein ($M_1+Cu_{1+2} + 1st A + 2d A$) has become lost, and not the true discoidal vein ($m+M_2$). The hind wing must therefore be regarded as highly specialized and not as primitive.

In the remaining characters, the Masaridinæ exhibit a

strange mixture of primitive (or generalized) and of specialized features. The inner orbits are, as a rule, deeply emarginate; the most notable exceptions being the Australian *Paragia*, in which they are merely sinuate (they are, however, distinctly emarginate in the allied *Metaparagia*, likewise of Australia), the South African *Ceramioides*, in which the emargination is very broad and shallow (the related *Ceramius* and *Paraceramius* have it quite deep), and the South American *Ceramiopsis*. Since the emargination of the eyes is commonly found in other related families of Hymenoptera, such as Scoliidæ, Sapygidæ, and Mutillidæ, it is most probably a very old character, inherited from the common ancestral stock of all Diploptera. In this case the sinuate or subentire inner orbits should be regarded as a secondary or specialized condition.

The mandibles are generally broad and short, folding over each other beneath the labrum or very slightly decusate. This may be regarded as the primitive condition retained by many Vespidæ (except Eumeninæ and Stenogastrinæ).

The clypeus is either truncate at apex or very broadly rounded, the more common and evidently primary condition among the Diploptera, where the pointed clypeus is only found as the rule in Ropalidiinæ, Polistinæ, Polybiinæ, and Stenogastrinæ, and very exceptionally elsewhere.

The antennæ are always composed of twelve segments in both female and male, although the terminal segments are often coalescing and hard to differentiate in the male.¹ In almost all other Vespidæ (including Gayellinæ and Euparagiinæ) the number of segments differs in the two sexes: as a rule it is 12 in the female and 13 in the male; in certain genera (*Belonogaster*, *Polybioides*) it is 11 in the female and 12 in the male. Another exception to the rule is the genus *Pachodynerus*, among the Eumeninæ, where both sexes have 12 segments. Many Masaridinæ show a marked tendency to a shortening of the scape and to a

¹Bradley (1922, *Op. cit.*, p. 389) states that in the female of *Trimeria* the antenna has only 11 segments. He had, however, not examined a specimen of that sex. In a female of *T. buyssoni* before me the antenna is distinctly 12-segmented.

swelling of the terminal segments of the flagellum into a club. But this is far from being the rule, since the antennæ of *Trimeria*, *Microtrimeria*, *Ceramius*, *Paraceramius*, *Ceramioides*, *Paragia*, and *Metaparagia* have the flagellum not more swollen than many members of the other subfamilies. The equal number of antennal segments in both sexes should, I believe, be regarded as primitive.

The mouth-parts are of two distinct types. In *Paragia* and *Metaparagia*, they have retained the more primitive condition, as is also the rule among the other subfamilies of Vespidæ: the ligula is short and not retractile, composed of two short glossæ which are but little longer than the paraglossæ; the palpi are well developed, the maxillary palpi 6-segmented, the labial palpi 4-segmented. In the remaining genera of Masaridinæ, the mouth-parts are highly specialized, being modified into a proboscis, or sucking tube, composed of the elongate, retractile glossæ which are much longer than the paraglossæ; when withdrawn in the buccal cavity, the labium forms a loop which may enormously distend the membrane of the neck; the maxilla, however, remains short, and there is often a reduction of the number of segments of the palpi. This modification of the trophi is, as we shall see, correlated with the highly specialized, anthophilous diet of these wasps. Unfortunately the habits of *Paragia* and *Metaparagia* are as yet entirely unknown, but it is possible that they may show some relation to the different structure of their mouth-parts. It should be noted that the proboscis of the anthophilous Masaridinæ, although having the same function as that of the Apoidea, or bees, has a different morphology, since the maxillæ and labial palpi never form any part of it.

The most striking feature of the thorax is the unusual development of the scutellum which shows a tendency to overlap and crowd out the postscutellum. This character is, however, present in *Euparagia* also. The parapsidal furrows are completely preserved in some genera (*Trimeria*, *Microtrimeria*, *Paragia*, *Masariella*, *Ceramius*); in others they are indistinct (*Paraceramius*, *Jugurtia*) or absent (*Masaris*, *Pseudomasaris*, *Celonites*). The mesepisternum may either show the primitive division into an upper and a

lower plate (*Trimeria*, *Microtrimeria*, *Masariella*, *Ceramioides*) or have the plates partly (*Ceramius*, *Paraceramius*) or completely (*Masaris*, *Pseudomasaris*) fused.

H. de Saussure attached a considerable importance to the number of spurs of the middle tibia, which he believed to be two throughout the subfamily. Later observations have, however, shown that this number is not a subfamily character. In the Masaridinæ it is very variable, although fixed in each species and in most of the genera. Two spurs are found in *Microtrimeria*, *Paragia*, *Ceramius*, *Masaris*, *Masariella*, *Jugurtia*, *Celonites* and *Quartinia*; but in some cases, as in certain species of *Masariella*, the second spur is very small. On the other hand, *Trimeria*, *Paraceramius*, *Ceramioides*, and *Pseudomasaris* have but one spur. The two spurs probably represent the primitive condition. The tarsal claws likewise are variable, toothed in most genera, but simple in *Trimeria*, *Microtrimeria*, and *Pseudomasaris*.

Some of the peculiarities of the wing venation have been discussed above. As a rule the fore wing shows none of the longitudinal plaiting so characteristic of the Vespidae when these insects are at rest. It should be observed, however, that the plaiting is likewise lacking or vestigial in the Euparagiinæ and Gayellinæ; while some Masaridinæ, such as *Ceramius*, show a distinct indication of it and others, such as *Celonites* and *Quartinia*, have the wing as strongly plaited as *Vespa*. Resting *Celonites* place the folded wings against the under side of the abdomen, as observed by J. Lichtenstein for the Mediterranean *C. afer* and by H. Brauns for several South African species. Throughout the subfamily there are but two closed cubital cells, the second and third (R^4+R^5) of the other Vespidae being fused. To judge from the course of the two recurrent veins, it would seem that this feature of the wing was derived from the more common type of vespid venation, in which the second cubital cell (R^5) receives both recurrent veins, and not from the (perhaps more primitive) condition of the Euparagiinæ, Gayellinæ, and Raphiglossinæ in which the second and third cubital cells each receive a recurrent vein. Among the other subfamilies of Vespidae the fusion of the second and third cubital cells is exceptional (as in

Paraicaria, where it is possibly the rule, and *Paramasaris*, where it is variable) or abnormal. In the hind wing the anal lobe is well developed as in most other Vespidae (except Vespinae), but is a small, circular or oval flap; the preaxillary excision is a mere undulation of the hind margin.

The number of segments of the abdomen is the same as in the other Diploptera, six in the female and seven in the male; but the posterior segments are not or only partly retractile within the second. The abdomen is always elongate and depressed, the venter being often flattened; in *Celonites* it is even slightly concave beneath and sharply margined on the sides (as in the Chrysididae). The first segment is, as a rule, broadly truncate and "sessile" (that is articulated with the thorax without intervening stalk). Some of the South African *Ceramioides* have the first segment somewhat set off from the remainder of the abdomen or subpetiolate, and *Ceramiopsis* has the first segment narrowed into a short petiole.

HABITS AND LIFE HISTORY OF THE MASARIDINÆ

As stated above, the highly specialized trophi of most Masaridinæ are correlated with their peculiar habits. So far as known at present, these wasps differ from all other subfamilies of Diploptera in being exclusively plant-feeders in both the larval and adult stages.¹ The adults are anthophilous in both sexes and the females supply the larvæ with honey and pollen only. All other Vespidae are at least partly predaceous and their larvæ feed exclusively or mostly upon animal prey. The only possible exception is *Nectarina*, a genus of honey-storing social wasps; but I have been unable to find definite observations showing that the larvæ of these wasps are fed on honey only. Even the Raphiglosinæ store insects for their larvæ, although the adults are

¹*Euparagia* is not a masarid wasp, but belongs to a distinct subfamily, Euparagiinæ, as shown by Bradley (1922, *Op. cit.*, p. 379). F. X. Williams (1927, *Pan-Pacific Entomologist*, IV, pp. 38-39) found that it is predaceous and stores its cells with curculionid larvae.

highly anthophilous and have the trophi as much modified into a proboscis as the Masaridinæ.²

That the Masaridinæ assiduously visit flowers has been observed in various parts of the world, but the genus or species of plant selected has not often been mentioned. This is, however, a point of some biological importance to which the attention of future observers should be called. From the few definite records it would appear that most of the species show a decided preference for flowers with fully-concealed nectar and, moreover, have a tendency to be oligotropic. In a given locality every species gathers pollen and nectar from one or a few species of plants, at least at one particular season.

Time has not allowed me to collect all observations scattered in the literature of Masaridinæ visiting flowers, but the following are believed to be representative for the group. In South Africa, according to H. Brauns, the species of *Celonites*, *Masariella*, *Ceramius*, and *Quartinia* all visit flowers actively, but the species of plants selected are not mentioned. In the Mediterranean Subregion, I have taken *Quartinia major* Kohl at flowers of *Chrysanthemum Myconis* Linnæus (near Algiers) and *Celonites afer* Lepeletier at those of *Echium confusum* de Coincy (near Oran). Dours mentions that he took *Celonites afer* and *Jugurtia oraniensis* (Lepeletier) in Algeria at flowers of *Bupleurum maritimum* Linnæus. *Celonites abbreviatus* (Villers) was observed by H. Loew visiting *Calamintha alpina* (Linnæus) (at Pontresina) and by H. Friese on *Teucrium montanum* Linnæus (in Thuringia). In Paraguay, *Trimeria howardi* Bertoni was seen by de Winkelried Bertoni visiting the flowers of *Talinum patens* (Jacquin). Much more complete are the observations relating to the North American *Pseudomasaris*. Some of these have been given above. In addition, *P. vespoides* (Cresson) has been observed by A. Davidson, in California, visiting *Pentstemon spectabilis* Thurber; by Cockerell, in New Mexico, eating the pollen of a species of *Pentstemon*; and by F. E. Clements and F. L. Long, in the

²The habits of the Gayellinae (*Gayella* and *Paramasaris*) are totally unknown.

region of Pike's Peak, Colorado, at the flowers of *Calochortus Gunnisonii* Watson, *Geranium cæspitosum* James, *Mertensia ciliata* (Torrey) (= *sibirica* Don), *Monarda fistulosa* Linnæus, *Prunus melanocarpa* (A. Nelson) (= *demissa* of authors), *Pentstemon glaber* Pursh, *P. glaucus* Graham, *P. gracilis* Nuttall, *Rubus deliciosus* James, and *R. strigosus* Michaux. Bradley records *P. texanus* subsp. *neomexicanus* Rohwer at flowers of *Astragalus*, *P. phaceliæ* Rohwer at those of *Phacelia neomexicana* Thurber, and *P. coquilletti* Rohwer at those of *Eriodictyon crassifolium* Bentham.

Since the nesting habits are known for only a few of the genera, it may be useful to review them briefly. Our most important lacuna in this respect concerns the Australian genera *Paragia* and *Metaparagia*, the behavior of which may well be totally different from that of the other Masaridinæ.

Celonites.—The nesting habits of *Celonites abbreviatus* (Villers) were first described by J. Lichtenstein (1869, Ann. Soc. Ent. France, (4) IX, Bull., p. xxix) after observations made by H. Westphal in southern France. The female builds free cells of mud which she places one behind the other on dry stalks of plants and in which she stores a honey paste as food for the larva. (Some additional details are given by J. Giraud, 1871, Ann. Soc. Ent. France, (5) I, p. 379). More complete observations were made with this species by C. Fertou (1901, Ann. Soc. Ent. France, LXX, p. 139; and 1910, *Op cit.*, LXXIX, pp. 174-176), also in southern France. He found the nest fixed to stones. He states that the female lays the egg first, before bringing in any provisions, and that the full-grown larva lines the walls of the cell with a thin layer of silk. His account also seems to indicate that the female uses mass provisioning.

C. afer Lepeletier (= *C. fischeri* of authors, not of Spinola) was likewise studied in southern France by J. Lichtenstein (1875, Ann. Soc. Ent. France, (5) V, Bull., p. ccxi), who found its habits similar to those of *C. abbreviatus*. Nurse, near Aden, southern Arabia, also bred from cylindrical mud cells a species referred by Bingham to *C. fischeri* (C. T. Bingham, 1898, Jl. Bombay Nat Hist. Soc., XII, 1, p. 111).

Ceramius.—Fonscolombe (1835, Ann. Soc. Ent. France, IV, p. 421), in southern France, observed a female of *C. fonscolombei* Latreille entering a gallery burrowed in the soil and provided at the entrance with a chimney of mud.

In South Africa, according to H. Brauns (1911, Zeitschr. Wiss. Insektenbiol., VI, pp. 387 and 445-446), *C. beyeri* Brauns, *C. lichtensteini* (Klug) and its var. *macrocephalus* H. de Saussure, likewise nest in the soil, building an erect or curved, free chimney of mud at the entrance. In *C. lichtensteini*, the female excavates a chamber at the end of the gallery, sometimes at a depth of four to five feet; here she masons oval cells of mud, in which she feeds the larvæ from day to day with flower nectar.

Paraceramius.—J. Giraud (1871, Ann. Soc. Ent. France, (5) I, pp. 375-379) has given a good account of the habits of *P. lusitanicus* (Klug), of which he observed a populous colony in southern France. The nest is similar to that of *C. fonscolombei* and likewise provided with a chimney at the entrance. At the end of the subterranean gallery the female masons a mud cell in which she feeds the larva from day to day with a mixture of pollen and nectar. C. Ferton (1901, Ann. Soc. Ent. France, LXX, pp. 137-139) completed these observations. He noted that the egg was laid in the bottom of the cell before the first load of honeypaste was brought in and that it was not attached to the wall by a thread. It would seem that he too observed progressive provisioning, although he is not explicit about this point.

Ceramioides.—The nesting habits have been observed in South Africa by H. Brauns (1911, *Op. cit.*) for *C. schulthessi* (Brauns), *C. linearis* (Klug) (= *C. fumipennis* Brauns), *C. bicolor* (Thunberg) (= *C. karrooensis* Brauns) and *C. capicola* (Brauns). They do not differ from those of *Ceramius lichtensteini*. The entrance to the nest may be protected either by a free chimney, erect or curved, or by a tunnel built on the ground.

Pseudomasaris.—Ashmead first mentioned breeding *P. vespoïdes* from a free mudnest (1902, Canad. Entom., XXXIV, p. 219). A. Davidson (1913, Bull. S. California Ac.

Sci., XII, pp. 17-18) also said that this species builds lumps of mud, attached to rocks or twigs and of stony hardness. He claimed, however, that the cells were stored with insect larvæ, but he must have made a confusion with the nests of some other mud dauber, since Hicks' observations, recorded below, show conclusively that *P. vespoides* is a pollen provisioning wasp. T. D. A. Cockerell (1913, Proc. Ent. Soc. Washington, XV, p. 107) stated that this same species was bred by G. Robertson, at Redlands, California, from a nest having the shape of an inverted cone and composed principally of sand, fastened to the stem of some plant. C. H. Hicks' observations on *P. vespoides* (1927, Canad. Entom., LIX, pp. 75-79) are much more complete than those made on any other masarid wasp. He found that, near Boulder, Colorado, the extremely hard mud nests are attached to rocks. The number of cells varies from 2 to 13 in one nest, each cell being about 2 to 3 cm. high; they are all placed vertically side by side, so that the tops, each provided with a cup-shaped depression, are in a straight line. A store of pollen was found in some of the cells, while others of the same nest contained full-grown larvæ from which adult wasps were bred. It would appear that this species uses mass provisioning, since several closed cells were found each containing a large mass of pollen. Before pupating the mature larva spins a light brown, silky lining over the wall of the cell.

At one time it was believed that some at least of the Masaridinae might be parasitic wasps, but there is no evidence in support of this view. Dours claimed that *Celonites* was parasitic upon *Scolia* and his supposed observations were reproduced by H. de Saussure (1854, Et. Fam. Vesp., III, pp. 35-36). A. de Winkelried Bertoni (1921, Rev. Soc. Cientif. Paraguay, I, p. 11) also stated that his *Ceramiopsis paraguayensis* was parasitic of an anthophorid bee, because he saw this wasp entering a vertical gallery in the soil with a "mouth-piece" similar to that of *Epicharis obscura* Friese. But the inference is almost certainly erroneous, since we know that many masarids that nest in the ground build chimneys at the entrance to their galleries.

DISTRIBUTION OF THE MASARIDINÆ

Not the least remarkable feature of the subfamily Masaridinæ is its present discontinuous distribution, as shown on the map (Fig. 2). This is further emphasized by an examination of the area occupied by the several genera.

Paragia.—20 species in Australia, 1 in Tasmania.¹

Metaparagia.—3 species in Australia.

Ceramiopsis.—2 species in southern Brazil and Paraguay.

Trimeria.—5 species in subtropical South America.

Microtrimeria.—1 species in Peru.

Ceramius.—4 species in the Mediterranean Subregion and 7 in South Africa. Several of the South African species are known from females only; some of these may be only color variations, while others are perhaps to be placed in *Ceramioides*. *C. lichtensteini* (Klug) is a true *Ceramius*. On the other hand, *C. beyeri* Brauns combines some of the characters of *Ceramius* (middle tibiæ with two spurs and venter of the male unarmed) and *Ceramioides* (eyes very shallowly emarginate).

Paraceramius.—2 species in the Mediterranean Subregion, and 1 in Korea. The South African species listed by Bradley (1922, *Op. cit.*, p. 396) belongs in *Ceramioides*.

Ceramioides.—7 species in South Africa. Here should be placed *C. bicolor* (Thunberg) (= *C. karrooensis* Brauns), *C. consobrinus* H. de Saussure, and *C. linearis* Klug (of which *C. fumipennis* Brauns is a synonym according to information received by letter from Dr. H. Brauns).

Jugurtia.—4 species in the Mediterranean Subregion (as far as Transcaspia and Persia) and 1 species in Gambia. The British Museum collection contains two specimens from

¹Through a curious oversight, Tillyard (1928, 'The Insects of Australia and New Zealand,' p. 296) calls these Australian masarids *Euparagia*, which is the name of a strictly North American genus not belonging to the Masaridinæ.

Northern Nigeria which may belong to an undescribed species.

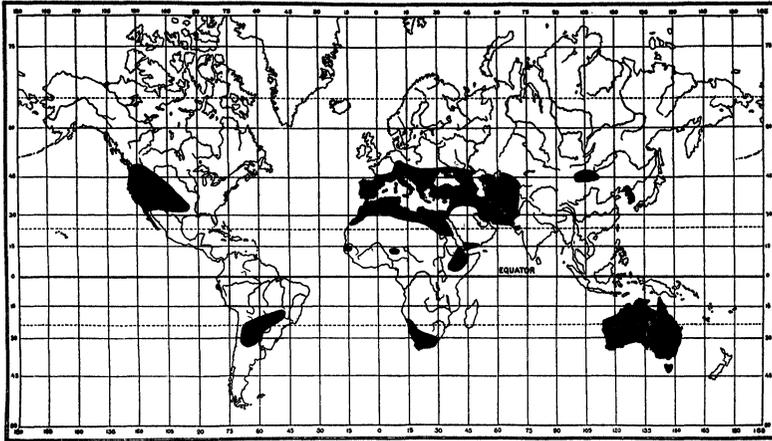


Fig. 2. Map showing the distribution of the subfamily Masaridinae.

Colonites.—9 species in the Mediterranean Subregion (as far as Turkestan; one of these species has also been recorded from southern Arabia), 1 in northwestern India, 2 in East Africa (Obock, Abyssinia, and northern Kenya Colony), and 7 in South Africa.

Quartinia.—4 species in the Mediterranean Subregion, 1 in Mongolia, 1 in northwestern India, and 2 in South Africa.

Masariella.—5 species in South Africa.

Masaris.—4 species in the Mediterranean Subregion (as far as Turkestan).

Pseudomasaris.—14 species in the western United States, from the southern part of British Columbia to Lower California and eastward to Colorado and Texas.

In appraising the endemism of the several genera, one should be aware of the fact that they are of unequal value.

According to their natural affinities they may be grouped as follows:

(1) *Paragia* and *Metaparagia* occupy an isolated position in the subfamily and have rightly been separated by Bradley (1922 *Op. cit.*, p. 388) as a distinct tribe, Paragiini. They are restricted to the Australian Region, where no other masarids are known to occur.

(2) *Ceramiopsis* is strictly Neotropical.

(3) *Trimeria* and *Microtrimeria* are also strictly Neotropical.

(4) *Ceramius*, *Paraceramius*, and *Ceramioides* are extremely closely allied and should perhaps be regarded as of subgeneric value only. This group is Palæarctic and South African.

(5) *Quartinia* is found in the Palæarctic Region and in South Africa.

(6) *Jugurtia* and *Celonites* are Palæarctic and Ethiopian.

(7) *Masaris*, *Pseudomasaris*, and *Masariella* are Palæarctic, Nearctic and South African.

A study of the map brings out the interesting fact that the distribution of the Masaridinæ does not fit in the customary scheme of zoögeographical regions based upon the terrestrial faunæ as a whole. On the contrary, these wasps are restricted to a series of disconnected areas, often of relatively small extent and separated by extensive tracts of country where they are entirely lacking. A wide and discontinuous distribution of that type is generally explained on the theory that it is the remnant or result of a more extensive and more or less continuous area occupied by the group or its immediate ancestors during former geological periods. In the case of the Masaridinæ no paleontological evidence can be adduced in support of this view, and we must rely entirely upon analogy of their present-day distribution with that of certain other animals where such evidence is available. Three analogous cases may be briefly

mentioned. The present distribution of the Masaridinæ is almost exactly matched by that of the dipterous family Nemestrinidæ, which is known with certainty from the Miocene and may even have existed during the Jurassic¹. The living Onychophora (*Peripatus* and allies) exhibit a distribution of a somewhat different type, yet distinctly composed of disconnected areas (See the map given by C. T. Brues, 1923, *American Naturalist*, LVII, p. 211); their extreme antiquity has been demonstrated by the discovery of one species in the middle Cambrian rocks of North America, although the group is no longer found living in that part of the world. The marine genus *Pleurotomaria* is one of the oldest groups of Gasteropoda: over 400 species are known from Palæozoic rocks, from the Cambrian on, and it was also abundant during the Jurassic; it was much rarer during the Tertiary; in the modern seas it is represented by only five or six living species, two in the Antilles, two or three in Japan, and one in the Moluccas.

A closer examination of the distribution of the Masaridinæ brings out some other items of interest. In the Palæarctic Region, these wasps are almost restricted to the Mediterranean Subregion which possesses 27 species of six genera: *Ceramius*, *Paraceramius* (endemic), *Jugurtia*, *Quartinia*, *Celonites*, and *Masaris* (endemic). Only one species, *Celonites abbreviatus* (Villers), extends into Central Europe, being found in Austria, Switzerland, and southern Germany (northernmost locality: Weissenfels near Leipzig, in about 51° N. lat.). *Quartinia* and *Celonites* are each represented by one species in the extreme northwestern corner of India, a region which may be regarded as an extension of the Mediterranean Subregion. Otherwise the subfamily is absent from the Oriental Region. One species of *Quartinia* has been described from Mongolia and one species of *Paraceramius* from Korea, both these areas belonging to the Palæarctic Region.

In the Ethiopian Region, South Africa is unusually rich,

¹*Prohirmoneura jurassica* Handlirsch, described from the lithographic chalk (Malm) of Bavaria, is undoubtedly a nemestrinid. Yet, as it was based upon a single specimen, I feel somewhat doubtful of the correctness of the geological horizon to which it was referred.

with 28 species of five genera: *Ceramius*, *Ceramioides* (endemic), *Quartinia*, *Celonites*, and *Masariella* (endemic). The vast majority of these forms occur south of the Orange River; a few extend into the Orange Free State (to 29° S. lat.) and South West Africa (to 22° S. lat.). The three remaining Ethiopian species, of the genera *Jugurtia* and *Celonites*, are found in the Sudan (Gambia and Northern Nigeria) and in East Africa (Obock, Abyssinia, and Kenya Colony). The occurrence of one species of *Celonites* in southern Arabia should be mentioned here since that territory belongs zoögeographically to the Ethiopian Region. It is significant that the masarids avoid the West African Sub-region and the Malagasy Region.

The 24 species of the Australian Region all belong to the endemic genera *Paragia* and *Metaparagia* and are restricted to the Australian continent and Tasmania.

Only 8 species are known from the Neotropical Region, all belonging to three endemic genera: *Ceramiopsis*, *Trimeria*, and *Microtrimeria*. They occur in the arid or semi-arid parts of South America, avoiding entirely the tropical, moist, densely forested areas.

The Nearctic Region has 14 species, all belonging to one endemic genus, *Pseudomasaris*, the distribution of which has been indicated above. Its northernmost occurrence is at Princeton, British Columbia, in about 49° 30' N. lat.

The present-day localisation of the Masaridinæ in certain well-defined areas seems to be entirely due to the ecological conditions favored by these wasps. The overwhelming majority of the species occur in arid or semi-arid country only, or at least in regions characterized by a hot and relatively dry summer. These wasps may therefore be called xerophilous. They entirely avoid regions with a heavy and evenly distributed rainfall, whether in temperate or in tropical parts of the world. These ecological requirements, as well as the strictly vegetarian habits, also explain why most masarids are among the rarest of insects. In order to perpetuate the species, the adults must appear at the proper season, when the flora is at its best. This condition is, of course, entirely regulated by the rains, which in desertic and semi-arid regions are always of short duration and

often erratic. Thus in the South African Karroo two or more years may pass without rain. As H. Brauns has shown (1911, *Op. cit.*, p. 446), the larvæ of *Ceramius* have the faculty of remaining in their underground cells without pupating throughout these long dry spells. In moister years, however, the adults are ready to hatch in early spring. As there are many arid parts of Central Asia, Arabia, the Sahara, and South America that have never been visited at the proper season by an entomologist, it is safe to prophesy that several species and perhaps even genera of masarids remain to be discovered. It is doubtful, however, whether future finds will materially alter the discontinuous distribution of the group, as known as present.

THE MASARIDINÆ AS AN ARCHAIC GROUP

It has been sometimes assumed that the masarid wasps are an archaic, or primitive, group of Vespidæ, but, so far as I know, no definite arguments have been brought forward in support of this opinion. I believe that this view, although correct in some respects, ought to be qualified, as I shall attempt to show presently.

The detailed discussion of the morphology of these wasps, given above, makes it clear, I think, that in almost every character of phylogenetic importance the Masaridinæ are either not more primitive than most other subfamilies of Vespidæ, or have retained primitive conditions in certain genera while being highly specialized in others. The most striking features of the masarid wing, *viz.*, the presence of only two closed cubital cells in the fore wing and the apparent lack of a discoidal vein in the hind wing, are evident specializations. As for the plaiting of the fore wing, it is indicated in certain species and it is as clearly marked in *Celonites* and *Quartinia* as in *Vespa*. The highly modified mouth-parts likewise preclude the possibility that the present-day Masaridinæ are anything like the ancestral stock of all the Diploptera. As a matter of fact the Gayellinæ and Euparagiinæ are in many features more primitive than the Masaridinæ, since they still have unplaited fore wings with three closed cubital cells, the second and third each receiving

a recurrent vein, while the hind wings have a distinct or large posterior lobe and at least a trace of a discoidal vein; in addition their trophi are not modified into a proboscis.

I am therefore unable to regard the Masaridinæ as a primitive or ancestral group. Nevertheless, they undoubtedly constitute an archaic unit, not derived from the immediate ancestors of the other subfamilies of Diploptera nor ancestral to them, but forming a very ancient, autochthonous line of descent. I am inclined to the view that at least five distinct, or independent, lines of descent may be recognized among the living Vespidæ, as follows:

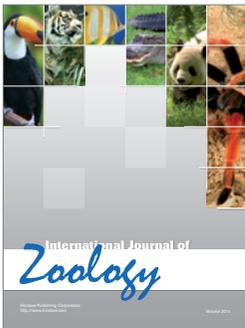
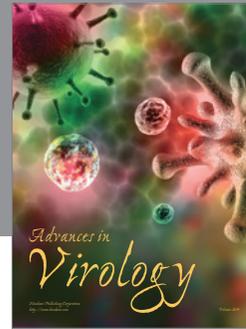
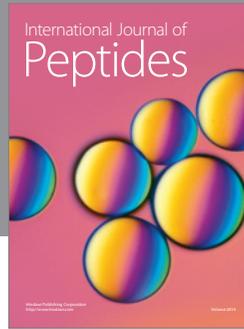
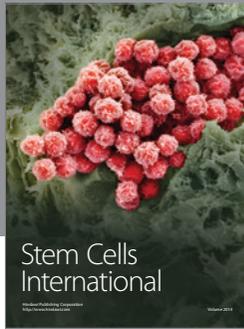
- (1) Subfamily Gayellinæ (*Gayella* and *Paramasaris*).
- (2) Subfamily Euparagiinæ (*Euparagia*).
- (3) Subfamily Masaridinæ.
- (4) Subfamily Vespinæ (*Vespa* and *Provespa*).
- (5) The remainder of the Vespidæ, comprising the subfamilies Polistinæ, Ropalidiinæ, Polybiinæ, Raphiglossinæ, Zethinæ, Eumeninæ and Stenogastrinæ.

As in many other ancient groups, that have persisted through long geological periods and have thus had time to mature, the Masaridinæ often exhibit extraordinary structural characters. They are the delight of the taxonomist and, in this respect, contrast sharply with the other Diploptera, the morphology of which is only too often of a despairing monotony. Most of the peculiar structures of the masarids are exaggerated secondary sexual characters of the males, the usefulness of which to the species is extremely doubtful or at least not apparent. These characters affect the shape of the antennæ, legs and abdominal segments. Sexual dimorphism is often so pronounced that the specific or even the generic connection between the two sexes is quite a problem.

One of the most convincing arguments in favor of the great antiquity of the Masaridinæ as a distinct subfamily, is their present-day discontinuous distribution, as I have sufficiently indicated above. One remarkable feature still should be mentioned, namely the absence of any close

relationship between the masarids of Australia, South Africa, and South America respectively. This group evidently gives no support to the partisans of land connections between these continents during late Mesozoic and Tertiary times.

In view of the highly specialized modification of the trophi into a proboscis correlated with strictly vegetarian habits, one may venture the hypothesis that the Masaridinæ represent an early attempt at evolving an anthophilous group of aculeate Hymenoptera, perhaps anterior to the evolution of the Apoidea (or bees) from a sphecoid stock. It may be supposed that during some former geological periods, these wasps were a predominant group, perhaps holding the same important position in the ecology of the phanerogams as is nowadays reserved to the bees. Their eventual decline, resulting in their present-day scarcity and discontinuous distribution, may have been brought about by the rising competition of the Apoidea, whose branched hairs and highly efficient collecting apparatus gave them considerable advantage as pollen gatherers and feeders over the masarid wasps.



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