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AN INTRODUCTORY STUDY OF POLISTES IN THE UNITED STATES AND CANADA WITH DE- SCRIPTIONS OF SOME NEW NORTH AND SOUTH AMERICAN FORMS (HYMENOPTERA; VESPIDÆ)

BY JOSEPH C. BEQUAERT

MUSEUM OF COMPARATIVE ZOÖLOGY, CAMBRIDGE, MASS.

Over ten thousand wasps have now been examined for the forthcoming revision of North American *Polistes*. Although I hope to study as many more before completing the work, the time has come to put on record some of the results, for the benefit of others. Moreover, the manuscript names distributed to various collections should be validated, according to the rules, without further delay.

In the United States I recognize four "structural species," only one of these entering Canada. Each species is represented by several color forms, or "varieties." The males of the four species are readily told apart; but most of the differentiating characters of the females or workers are subtle and difficult to put in words. They become gradually more apparent as one examines more specimens. This should be kept in mind when using the subjoined key. In all social species of *Polistes* with which I am acquainted, the workers (when present) and fertile females (or queens) are alike, both in structure and color and often also in size. It is generally assumed that the smaller females, sometimes found in the colony, are workers. Moreover, even unmated females (or workers) may occasionally lay eggs, which develop by parthenogenesis into male wasps.

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KEY TO SPECIES

1. Body slender. Abdomen elongate-fusiform, widest about mid-length, more or less compressed apically; first tergite slightly convex in profile and gradually sloping onto the base, seen from above slightly longer than wide at apex. Second sternite little convex, not bulging in profile. Apical sternite of male without medio-basal tubercle..... 2.
- Body thickset. Abdomen ovate-fusiform, widest before middle, more or less depressed apically; first tergite strongly convex in profile and rather abruptly sloping onto the base, seen from above as wide at apex as long or wider. Second sternite strongly convex, bulging in profile. Mesopleura with microscopic sculpture only..... 3.
2. Propodeum distinctly striate transversely throughout. Mesopleura with many large punctures scattered in the microscopic sculpture. Collar of pronotum high and sharp, forming raised humeral angles. Clypeus of female touching the eyes over a distance at most half the length of the oculo-malar space. Clypeus of male subquadrate and flattened, contiguous to the eyes..... *P. canadensis*.
- Propodeum very finely striate, except in the median groove. Mesopleura with the microscopic sculpture only, without larger punctures. Collar of pronotum low and blunt, weakly projecting at the humeri. Clypeus of female touching the eyes over a distance about equal to the length of the oculo-malar space. Clypeus of male irregularly heptagonal and slightly convex, broadly contiguous to the eyes..... *P. exclamans*.
3. Propodeum coarsely striate throughout, with some 20 to 22 strong transverse ridges. Mesopleura often with at least traces of a prepectal suture running obliquely upward on the anterior convexity. Clypeus of female touching the eyes over a distance at most half the length of the oculo-malar space. Clypeus of male subquadrate, with the anterior margin straight or very slightly convex, the sides always widely separated from the eyes. Apical sternite of male without medio-basal tubercle *P. major*.
- Propodeum finely or moderately striate, usually more strongly in the median groove, the striae numerous but not ridge-like. Mesopleura never with a trace of a prepectal suture, the anterior convexity smooth. Clypeus of female touching the eyes over a distance equal to one-half or more of the length of the oculo-malar space. Clypeus of male irregularly hexagonal, more or less broadly separated from the eyes (often scarcely so). Apical sternite of male with a small but distinct medio-basal tubercle..... *P. fuscatus*.

Two names proposed for North American *Polistes* remain a puzzle. In 1872 (Trans. Amer. Ent. Soc., IV, pp. 245-246) Cresson described *P. perplexus* and *P. generosus*, both based on males only, from Texas. I have studied his types at the Philadelphia Academy of Sciences, on several occasions. There can

be no doubt that *P. generosus* is only a variant of *P. perplexus*, as Cresson surmised, and it should be treated as a synonym of the latter. These males agree in every important structural character with *P. fuscatus* and at one time I regarded them as aberrant males of typical *fuscatus*. They are unusual, however, in being larger and especially stouter than the regular males of even var. *metricus* and var. *rubiginosus*. I have in my collection 12 males from Texas (some without more definite locality; others from College Station, Shiloh and Brazos Co.), 1 male from Kentucky (Woodford) and 1 male from Indiana (Bloomington), which cannot be separated from *perplexus* and *generosus*. I have also 6 females from Texas (some without more definite locality; others from Austin and College Station) and 1 female from Indiana (without more definite locality), which appear to be the other sex of Cresson's *perplexus* and *generosus*. These females also are unusually large and stout for forms of *P. fuscatus*. In both sexes these supposed *perplexus* wasps give the impression of being more powerful insects, with very strong striation of the propodeum, the head more swollen (particularly the outer orbits) and the legs and antennæ slightly shorter and stouter. I have been unable, however, to find more tangible structural differences from *P. fuscatus*. I should have attached little importance to the more powerful build of these supposed *perplexus*, were it not for the possibility that they may represent a distinct species, living as a social parasite in the colonies of either var. *metricus* or var. *rubiginosus*. This parasitic species may have been derived so recently from its social ancestor (presumably some form of *P. fuscatus*), that it has as yet developed no cogent structural differences. Several Palearctic species of *Polistes* are now known to be true social parasites (W. Weyrauch, 1937, Zool. Jahrb., Abt. Syst. Tiere, LXX, pp. 243-290) and I have suggested recently that some of the Ethiopian species have similar parasitic habits (J. Bequaert, 1938, Rev. Zool. Bot. Afric., XXXI, p. 130). No doubt parasitic *Polistes* will also be discovered in the New World. Carefully controlled observations in the field alone will enable one to decide whether or not my surmise is correct in the case of *P. perplexus*. If it is a true social parasite, the species will consist only of males and impregnated females. The females will build no nests nor form colonies of their own. Instead, they will

seek out existing colonies of some social *Polistes*, in which to deposit their eggs. The larvæ hatching from these alien eggs will then be raised by the original and rightful builders and inhabitants of the nest.

The wasps recorded as *P. perplexus*, from Bermuda, by W. F. Kirby, Verrill and Ogilvie, are *P. fuscatus* var. *nestor* (Fabricius).

Vespa carolina Linnaeus (1767, Syst. Nat. 12th Ed., I, pt. 2, p. 948), from Carolina, was undoubtedly based upon a North American *Polistes*, as I have pointed out before (1931, Entomologica Americana, XII, p. 108). The type is so poorly preserved and the description so inadequate, that it is impossible to decide whether it was *P. canadensis* var. *annularis* or one of the forms of *P. fuscatus* (possibly a male of *P. fuscatus* var. *rubiginosus*). For this reason, it seems preferable to drop the name altogether.

The following names have been applied erroneously to *Polistes* of our territory.

P. crinitus (Felton).—This is a strictly West Indian wasp, structurally distinct from the four North American species. Its nearest relative in North America is *P. exclamans*, which has sometimes been mistaken for it.

P. minor Palisot de Beauvois, described originally from Santo Domingo, is also strictly West Indian in my opinion. The wasps frequently called *P. minor* in the United States are usually *P. fuscatus* var. *hunteri*, sometimes *P. exclamans*.

P. carnifex (Fabricius) is occasionally confused with *P. major*. True *carnifex*, as characterized in 1936, Rev. de Entomologia, VI, pp. 376–383, I have never seen from the United States or the West Indies.

P. instabilis H. de Saussure was recorded by F. Smith (1857) from East Florida, Mount Pleasant (Ohio) and New York. True *instabilis*, however, is a Central American wasp (See under *P. exclamans*).

In the enumeration of species and varieties I have inserted the published names which I regard as synonyms, without further discussing the matter. The opportunity has been used to publish the descriptions of some new color varieties from the West Indies, Central and South America.

In brief, only three forms of *Polistes fuscatus* are known with

certainty from Canada: var. *pallipes* (Quebec and Ontario), var. *connectens* (Alberta) and var. *aurifer* (British Columbia).—In the United States the following occur: *P. canadensis*, typical, *P. canadensis* var. *annularis*, *P. canadensis* var. *comanchus*, *P. canadensis* var. *kaibabensis*, *P. canadensis* var. *navajoe*, *P. exclamans*, typical, *P. exclamans* var. *louisianus*, *P. major*, typical, *P. major* var. *palmarum*, *P. major* var. *castaneicolor*, *P. major* var. *bakeri*, *P. fuscatus*, typical, *P. fuscatus* var. *anaheimensis*, *P. fuscatus* var. *apachus*, *P. fuscatus* var. *aurifer*, *P. fuscatus* var. *centralis*, *P. fuscatus* var. *bellicosus*, *P. fuscatus* var. *connectens*, *P. fuscatus* var. *flavus*, *P. fuscatus* var. *hunteri*, *P. fuscatus* var. *metricus*, *P. fuscatus* var. *montanus*, *P. fuscatus* var. *nestor*, *P. fuscatus* var. *pallipes*, *P. fuscatus* var. *rubiginosus*, *P. fuscatus* var. *utahensis*, and *P. fuscatus* var. *variatus*.

The North American *Polistes*, like those of other parts of the world, are quite variable in the extent, arrangement and shade of color markings. The extreme case is perhaps that of *P. fuscatus*, in which color seems to run riot and to defy any attempt at rational analysis. The true meaning of these variations as yet escapes us, although a theory is by no means lacking. What we really should know, before attempting to build up theories, is the genetic background of the color differences, whether or not and to what extent they are hereditary in a given population and how they behave when crossed; also to what extent they may be influenced by environmental conditions (nature and amount of food, climate, resistance to disease, natural selection by predators, etc.). It would seem that only experiments can furnish decisive answers to these questions. Meanwhile, from observation alone, the several color variations of one structural species appear to be of unequal value, hence probably due to different causes. At least four types of variants may be recognized.

(1) Some variations may be purely individual or fluctuating and probably due entirely to environmental conditions during the ontogeny. It is frequently difficult to find two individuals colored alike in every detail, even within the same population or among the offspring of a single queen. The differences among the inmates of one nest may, however, be explained to some extent by the frequent association of two or more queens in the found-

ing of a new colony (pleometrosis: See J. Bequaert, 1923, Bull. Brooklyn Ent. Soc., XVIII, pp. 73-80).

(2) Sometimes two or more variants occur in the same locality, which, though quite distinct in the extreme or "typical" individuals, yet are connected by many intergrades. In most cases the intergrades are probably hybrids. In the northeastern United States, for instance, one finds three forms of *P. fuscatus*:¹ (a) typical *fuscatus* is relatively uncommon in the central part of this area, from southern Massachusetts to West Virginia; (b) the var. *nestor* is common from southern Pennsylvania to South Carolina and eastern Texas, with an occasional specimen in New Jersey and on Long Island; (c) the var. *pallipes* is characteristic of southern Canada, New England, and northern New York, with a few stragglers farther south in the Alleghany Mountains. From the distribution and relative scarcity, it would seem that typical *fuscatus* (as described by Fabricius) may not be a distinct "race" at all, but merely a name or label for hybrids between *pallipes* and *nestor*, where the ranges of these two forms overlap.

(3) Two or more variants of a species may occur over much the same territory, yet be so well defined that intergrades are hardly ever met with. Thus in the mid-western States, particularly in the drainage of the Mississippi, one finds commonly in one locality three varieties of *P. fuscatus*, viz., *variatus*, *metricus* and *rubiginosus*. Each by itself is more or less variable, but specimens that might be regarded as connecting two of them are exceedingly rare or lacking. Their scarcity rather indicates that, in this case, such intermediate specimens are merely extreme individual variants, not true intergrades or hybrids. Perhaps we are dealing here with ecological, physiological or even behavioristic races. Phil Rau has shown, for instance, that in the region of St. Louis, Missouri, three color forms of *Polistes fuscatus* nest in different types of environment (1931, Bull. Brooklyn Ent. Soc., XXVI, pp. 111-116). The "isolation" of such races may be enhanced by the social behavior, brothers and sisters tending to mate on or near the nest, while young queens often return to their mother's nesting site. In any case, the correlation be-

¹ As is the rule in *P. fuscatus*, these three forms are recognizable in the female and worker only. The males of this species rarely show the color differences on which the several varieties are based.

tween such extra-morphological differences and the visible color characters can only be fortuitous.²

(4) Finally, in a few cases the variants agree fairly well with the classic concept of "geographical races" or "subspecies." They are sharply defined, apparently without intergrades to other forms, and inhabit a limited district to the exclusion of other color variants of the same species. There are few clear-cut cases of this type among the variants of *P. fuscatus*, the nearest approach being perhaps the two forms of the Pacific Coast, var. *aurifer* and var. *anaheimensis*, although the areas of both overlap to some extent. Better examples are the variants of *P. canadensis*: var. *annularis* (in the southeastern States), var. *kaibabensis* (in the Grand Canyon of the Colorado River), var. *navajoe* (in the Upper Sonoran of Arizona), and var. *comanchus* (in the Upper Sonoran of southwestern Texas).

A corollary to the differentiation of "races" on a geographical basis is the convergence in color pattern, or homeochromy, sometimes exhibited by several structural species of *Polistes*, other wasps or other insects in general, occurring in the same area. Illustrations of this are few in the North American *Polistes*. There is, however, a decided superficial resemblance between *P. fuscatus* var. *metricus* and *P. canadensis* var. *annularis*, in the southeastern States; between typical *P. exclamans* and *P. fuscatus* var. *bellicosus*, in the southeastern States; and between *P. canadensis* var. *navajoe* and *Mischocyttarus flavitarsis* var. *navajoe* in Arizona. Whether or not these are cases of "protective coloration," I shall not attempt to discuss.

Polistes canadensis (Linnæus)

The most widely distributed American species of the genus, although it does not reach Canada. Linnæus was evidently misled as to the locality of his specimens, like in so many other cases. It extends from south of the Great Lakes and Utah to northern Patagonia. It is, however, unknown in California and Chile. In this vast territory it has produced several color forms, thirteen of which have been named thus far. Four more are

² A similar fortuitous correlation exists, for instance, between the egg-pattern and the physiological differences of the several races of *Anopheles maculipennis*.

described below. Of these seventeen varieties, five only occur in the United States.

KEY TO NEARCTIC COLOR FORMS OF *P. CANADENSIS*

1. Abdomen either without yellow markings, or the first tergite only with an apical yellow margin 2.
 Abdomen more extensively yellow or orange-yellow, particularly over the third and succeeding segments, which are often almost entirely of that color 3.
2. Body fairly uniformly light to dark mahogany-brown, the head and thorax sometimes lighter than the abdomen. Yellow apical margin of first tergite more or less distinct, sometimes lacking. Wings purplish-black, sometimes with a russet tinge, which becomes gradually more pronounced apically, the veins and stigma either black or russet according to the color of the surrounding membrane typical *canadensis*.
 Head and thorax dark mahogany-brown, sometimes blotched with black; abdomen usually jet-black, blotched with mahogany-brown on the first segment and occasionally elsewhere. First tergite always with a distinct yellow apical margin. Wings uniformly deep purplish-black, the veins and stigma black var. *annularis*.
3. Head, thorax, legs, and abdomen light reddish-brown, with extensive yellow markings on head and abdomen. Wings ferruginous, very slightly purplish; costal area, veins and stigma russet var. *kaibabensis*.
 Ground color of head, thorax, and legs black 4.
4. Head black, extensively marked with orange-yellow; thorax black, only narrow margins of pronotum and tegulae orange; abdomen mostly orange-yellow, elsewhere ferruginous, only the base of first tergite black. Wings ferruginous, slightly purplish, the veins and stigma russet.
 var. *comanchus*.
 Head black, extensively marked with yellow; thorax black, the pronotum partly, tegulae and scutellum orange-yellow; abdomen mostly yellow, elsewhere black, the first and second tergites somewhat reddish at the limits of black and yellow areas. Wings strongly purplish-black, only extreme base and costal area somewhat russet, the veins and stigma black var. *navajoe*.

1. *P. canadensis*, typical.—Distributed over most of the Neotropical Region. I have seen it from Mexico, Guatemala, Honduras (Rep.), Colombia, Venezuela, British Guiana, Trinidad, Brazil, Peru, Bolivia and Paraguay. It barely enters the United States at the southern border of Arizona. Two females taken at Nogales by Dr. J. C. Bradley are exactly like a series I have received from Vera Cruz and Sonora (Bakachaka; Estrella District, Alamos).

2. *P. canadensis* var. *amazonicus* W. A. Schulz.—Known from Brazil, British Guiana, Panama, Ecuador and British Honduras.

3. *P. canadensis* var. *annularis* (Linnæus).—*Vespa cincta* Drury (1773), *Vespa virginiensis* "Drury" Dalla Torre (1894) and *Polistes annulata* Moebius (1856) are synonyms. The most widely distributed form of the species in the United States. I have seen it from Connecticut (New Haven), southern New York (Ft. Montgomery; Hillburn; Orient, Long Island; Ramapo Mts.; also taken many years ago on Staten Island by Mr. Wm. T. Davis), New Jersey (Paterson; Jamesburg; Cape May), Pennsylvania (Pittsburgh), Maryland, Virginia, District of Columbia, West Virginia, southern Ohio (Hocking Co.; Sugar Grove, Ross Co.; Clifton, Greene Co.), southern Indiana, southern Illinois (New Columbia; Fort Chartres State Pk.), southern Iowa (Page Co.), Missouri, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Oklahoma, eastern Kansas (Blue Rapids), and eastern Texas (as far west as Bexar Co.). It will be found also in Delaware, Arkansas, and southeastern Nebraska. It is not known from south of 42°, west of the 100th Meridian, or outside the United States.

4. *P. canadensis* var. *buyssoni* Brèthes, 1909, An. Mus. Nac. Buenos Aires, (3) X, p. 456.—Syn.: *Polistes cavapyta* var. *thoracica* R. du Buysson, 1906, Ent. Medd., Copenhagen, III, p. 19. Not *Polistes thoracicus* Fox, 1898. This form is common in certain parts of Argentina.

5. *P. canadensis* var. *cavapyta* de Saussure.—*Polistes opalinus* de Saussure appears to be a synonym. A form of northern Argentina, southern Brazil, Uruguay and Paraguay.

6. *P. canadensis* var. *cinctus* Lepeletier.—*Vespa* (*Polistes*) *dominica* Vallot (1802) may be the same. A form peculiar to the lesser Antilles, where it is known from Martinique, St. Vincent, St. Kitts, the Grenadines and Barbadoes. It was also introduced into Montserrat and St. Lucia, where it appears to have taken a foothold. This is one of the smaller forms of the species (fore wing 14 to 17 mm. long).

7. *P. canadensis* var. *comanchus* de Saussure.—This form is characteristic of the Upper Sonoran life zone of southwestern

Texas (Brewster Co.; Jeff Davis Co.). I have seen it also from the Sierra de los Burros, State of Coahuilla, Mexico.

8. *P. canadensis* var. *erythrocephalus* Latreille, 1817, in Humboldt and Bonpland, Recueil d'Observations de Zool. Anat. Comp., II, p. 96, Pl. XXXVIII, fig. 3 (♀; South America).—The description and figure leave no doubt as to the identity of this form. It is characterized by the jet-black thorax and abdomen, the ferruginous head and antennæ (except for the median black ring), the black legs with ferruginous or orange knees and tarsi, and the bluish-black wings. At one time I distributed it as a new variety with a name derived from Costa Rica. Dalla Torre overlooked Latreille's name. The var. *erythrocephalus* is found in Nicaragua (Sioux Plantation, Rio Grande; Eden), Costa Rica (common), Panama (common), parts of Colombia (Dept. Santander, Dept. Boyacá and Dept. Tolima), and southern Brazil (Sete Lagoas, State of Minas Geraes). It is sometimes called *P. rufidens* in collections, but de Saussure's *rufidens* is structurally distinct from *P. canadensis*.

9. *P. canadensis* var. *ferreri* H. de Saussure.—Uruguay and northern Argentina.

10. *P. canadensis* var. *kaibabensis* Hayward, 1932, Proc. Utah Ac. Sci., IX, p. 89, Pl. IX, figs. 4, 12, 13 and 16. This interesting form is known only from the rim of the Grand Canyon of the Colorado River, Arizona, where it is common.

11. *P. canadensis* var. *lanio* Fabricius.—I have seen this from Brazil and Peru.

12. *P. canadensis* var. (or subsp.) **mexicanus**, new.

Female and Worker.—Body and legs bright reddish-brown, only the sutures of the thorax, a median line over anterior half of mesonotum and a narrow stripe in concavity of propodeum (widened below), black; middle of flagellum infuscated; the following markings are yellow: apical fasciæ on all tergites and second to last sternites (reduced on first and second, very extensive on the others and more or less divided on each side by a wavy reddish line or sometimes emarginate) and the knees and hind tarsi more or less. Wings very strongly infuscate, purplish-black.

Male.—Colored exactly like the female.

Holotype: Cuernavaca, State of Morelos, MEXICO, female (G. Lassman).—*Allotype*: Cuernavaca, male (A. L. Melander).—*Paratypes*: Cuernavaca, four females and two males; Teotihuacan,

State of Mexico, MEXICO, two females (S. E. Jones); Valerio, Trujano, State of Oaxaca, MEXICO, two females (M. Embury and A. Mead).—Holotype, allotype and several paratypes at Museum of Comparative Zoölogy, Cambridge, Mass.; two paratypes in Dr. R. M. Bohart's collection.

This form is nearest to the Argentinian varieties *ferreri*, *cavapyta* and *buyssoni*, but the abdomen is more extensively marked with yellow than in *ferreri*, while the yellow markings of head and thorax of *cavapyta* and *buyssoni* are lacking. In the North American fauna it is nearest var. *kaibabensis* and var. *wheeleri*, differing from the former in the color of the wings and from both in the reddish-brown head.

13. *P. canadensis* var. *navajoe* Cresson.—A common form in Arizona, also found in northern Mexico: south of Nogales, State of Sonora (P. P. Calvert); Escuinapa, State of Sinaloa (J. H. Batty). Apparently characteristic of the Upper Sonoran life zone.

14. *P. canadensis* var. *panamensis* Holmgren.—Common in Panama and parts of Colombia (Santa Marta district).

15. *P. canadensis* var. (or subsp.) *satan*, new.

Female and Worker.—Head, thorax and abdomen jet-black, scarcely with any ferruginous or yellowish markings; a very narrow inner border of the eyes, outer orbits, lower portion of clypeus, mandibles, hind margin of pronotum and a blotch on tegulae, very slightly suffused with reddish-brown. Antennae black, base and apex more or less tinged with chestnut-brown. Legs black; base of tibiae, outer side of fore tibiae, and fore tarsi more or less ferruginous; mid and hind tarsi dirty yellow to orange. Wings uniformly bluish-black, with black veins and costa; stigma dark brown.

Male.—Almost exactly like the female; very narrow inner orbits dirty yellow.

Holotype: Lassance, State of Minas Geraes, BRAZIL, female (Cornell Univ. Exped.).—*Allotype*: Bello Horizonte, State of Minas Geraes, BRAZIL, male (Cornell Univ. Exped.).—*Paratypes*: Lassance, one male and six females; Pirapora, State of Minas Geraes, three females (Cornell Univ. Exped.); Fazenda do Diamante, Corinto, State of Minas Geraes, one female (Ynes Mefia); La Esperanza, Dept. Cundinamarca, COLOMBIA, one female (E. Roba).—Holotype, allotype and six paratypes in the Department of Entomology, Cornell University; four paratypes at Museum

of Comparative Zoölogy, Cambridge, Mass., and one paratype at the Academy of Natural Sciences of Philadelphia.

The extreme melanistic form of the species, differing from the var. *erythrocephalus* in having the head also practically entirely jet-black.

16. *P. canadensis* var. (or subsp.) **weberi**, new.

Female and Worker.—Mostly black, with brownish tinges over some of the abdominal segments; most of head, most of pronotum, tegulae, a small spot in upper corner of mesopleura, and antennae (except for median black area of flagellum), mahogany-brown. Pale sulphur-yellow markings restricted to the large apical margin of first tergite (emarginate in the middle and separated from the black base by a reddish-brown area), the knees, the basal half or more of all tibiae, and all tarsi. Wings strongly infuscated, purplish-black in basal two-thirds, more russet in apical third.

Male unknown.

Holotype: Macuto near La Guaira, VENEZUELA, female (Neal A. Weber).—*Paratypes*: Macuto, three females (N. A. Weber); Caracas, Venezuela, three females.—Holotype and paratypes at the Museum of Comparative Zoölogy, Cambridge, Mass.; paratypes also at the American Museum of Natural History.

In general coloration of body and wings the var. *weberi* resembles the varieties *panamensis* and *amazonicus*, but it differs from these in the large yellow margin of the first tergite. This margin is much more extensive than in var. *annularis*, which, moreover, has uniformly purplish-black wings. It recalls var. *cinctus*, of the Lesser Antilles, but that form is fairly uniformly reddish-brown with entirely yellowish-russet wings. The var. *weberi* is also larger (fore wing 20 to 22 mm. long). It was obtained in the arid coastal area of Venezuela, covered with xerophytic scrub forest and characterized by the cactus, *Cereus griseus*.

17. *P. canadensis* var. (or subsp.) **wheeleri**, new.

Female.—Body and legs bright reddish-brown; only the ocellar area, sutures of the thorax, a median line over anterior half of mesonotum and a narrow stripe in concavity of propodeum (widened below), black; middle of flagellum infuscated. The following markings are yellow: clypeus, lower half of face, most of outer orbits and mandibles, under side of scape, apical fasciae on all tergites and on second to last sternites (reduced on first and second, very extensive on the others and more or less divided on each side by a wavy reddish line), the knees, the basal third of all tibiae, and most of

all tarsi. Wings moderately infuscated, somewhat purplish-black and tinged with russet basally and along anterior margin.

Male unknown.

Holotype: Bochibampo Bay, Guayamas, State of Sonora, MEXICO, female, March 3, 1937 (Wm. M. Wheeler).—*Paratypes*: Copete Mine, 30 Kilom. east of Carbo, State of Sonora, 4 females (F. C. Nicholas).—*Holotype* at Museum of Comparative Zoölogy, Cambridge, Mass.; *paratypes* also at the American Museum of Natural History.

Related to the var. *mexicanus*, from the Central Plateau of Mexico, but distinct by the extensively yellow head and legs and the partly russet wings. It is also near var. *comanchus* (which has the thorax almost wholly black) and var. *kaibabensis* (which has uniformly russet wings).

***Polistes exclamans* Viereck**

In 1931, G. Salt and I described a *Polistes bahamensis*, with two color forms, var. *bilineolatus* and var. *picturatus*, all from the Bahamas. I have since recognized that these Bahaman wasps are structurally not separable from the continental *P. exclamans*. Two forms of *exclamans* occur in the United States.

Polistes instabilis H. de Saussure (Syn.: *P. oculatus* F. Smith), from Mexico, the Republic of Honduras and Costa Rica, resembles typical *P. exclamans* in color. The males are readily distinguished by the very bulging eyes, the subquadrate clypeus and the slender antennæ (with all segments of flagellum at least twice as long as thick). I have not yet found reliable structural differences in the female and worker.

1. *P. exclamans*, typical.—This is a common wasp in the southeastern United States. I have seen it from North Carolina, South Carolina, Georgia, Florida, Texas, Louisiana (Baton Rouge; Olivier), Oklahoma, Arkansas, Kansas, Colorado and Arizona. Although somewhat variable in color, it is always well marked with yellow, often profusely so; the propodeum bears usually four yellow stripes; the wings lack the yellow-russet tinge of the Bahaman varieties and the mesonotum seldom bears yellow longitudinal lines. Some specimens from Metacumbe Key and elsewhere on the east coast of Florida, are somewhat transitional

between typical *exclamans* and the var. *bilineolatus*. Typical *exclamans* is readily confused with *P. fuscatus* var. *hunteri* or *P. fuscatus* var. *bellicosus*, and in collections it is often called also *P. crinitus* or *P. minor*.

2. *P. exclamans* var. (or subsp.) ***louisianus***, new.

Female and Worker.—Reddish mahogany brown, with only the middle of the flagellum above, the extreme base of some of the abdominal segments and the outer side of the mid and hind tibiæ infusate or blackish. Pale markings ivory-white and scanty: a narrow hind margin to the pronotum, most of tegulæ, anterior angles of scutellum, linear anterior margin of postscutellum, an elongate spot on mesopleura (beneath tegulæ), two narrow median stripes on propodeum (sometimes lacking), linear apical margins on first to third abdominal tergites (more extensive on the first; sometimes lacking on the third), knees, bases of tibiæ, and most of tarsi. Wings as in typical form, uniformly infusate and purplish.

Holotype: New Orleans, LOUISIANA, female (Ed. Foster).—*Paratypes*: two females from the same locality.—Holotype and one paratype at U. S. National Museum; one paratype at Museum of Comparative Zoölogy, Cambridge, Mass.

In the absence of the male, the specific identity of this form is not quite certain. I suspected at first that these three wasps might be some form of either *P. crinitus* or *P. versicolor*, accidentally introduced by man. Structurally, however, the New Orleans wasps are indistinguishable from *P. exclamans*. On the other hand, I have never seen a specimen of either *P. crinitus* or *P. versicolor*, from Central and South America and the Antilles, colored like them. The reduction of yellow markings is quite unusual for *P. exclamans*.

3. *P. exclamans* var. *bahamensis* Bequaert and Salt (1931, Ann. Ent. Soc. America, XXIV, p. 793).—Known only from the Bahamas, where it occurs on Andros Island. This is the most distinct of the several color forms of the species.

4. *P. exclamans* var. *bilineolatus* Bequaert and Salt (1931, *op. cit.*, p. 796).—Known only from the Bahamas, where it is found on New Providence Island and Eleuthera.

5. *P. exclamans* var. *picturatus* Bequaert and Salt (1931, *op. cit.*, p. 797).—Known only from the Bahamas, where it is found on Acklin Island, Mariguana, Rum Cay, Crooked Island, Long Island, Watlings Island and Cat Island.

Polistes major Palisot de Beauvois

I have discussed this species on two previous occasions (1936, Ent. News, XLVII, pp. 7-13; 1937, Arch. Inst. Biol. Veget., Rio de Janeiro, III, pp. 173-174). It occurs from the southern United States to Brazil, as well as in the Bahamas, Cuba and Santo Domingo. It has recently been introduced into Puerto Rico.

KEY TO NEARCTIC COLOR FORMS OF *P. MAJOR*

1. Thorax more or less extensively marked with yellow. Abdomen with extensive yellow apical margins on all tergites, sometimes covering them almost entirely 2.
 Body almost uniformly dark chestnut-brown; only the tarsi and blotches on the head yellowish. Wings uniformly brownish, costal area somewhat russet, veins and stigma chestnut-brown var. *castaneicolor*.
2. Ground color of body light ferruginous-brown. Wings uniformly russet-fuscous, slightly purplish var. *palmarum*.
 Dark areas of body cinnamon-brown to blackish-brown. Wings dark cinnamon-brown, with a russet tinge and slightly purplish 3
3. Thorax very extensively marked with yellow, particularly on the propodeum typical *major*.
 Thorax with reduced yellow markings, which are absent on the propodeum var. *bakeri*.

1. *P. major*, typical.—Known from Mexico, Guatemala, the Republic of Honduras, Nicaragua, Brazil, Cuba, Isle of Pines, Santo Domingo, Navassa Island and the Bahamas; recently introduced into Puerto Rico. In the United States it has only been taken in a few localities of southern Arizona; these specimens are colored exactly like those from farther south and from the West Indies.

2. *P. major* var. (or subsp.) ***bakeri***, new.

Male.—Similar to typical *major*, but chrome-yellow markings much reduced on thorax, being restricted to collar of pronotum (narrowly above, very broadly on the sides) and part of scutellum and postscutellum (shading into cinnamon-brown); mesonotum, mesopleura, metapleura and propodeum black; major part of pronotum, four elongate spots on mesonotum and small spot on upper part of mesopleura, reddish-brown.

Female or Worker.—Agreeing with the male in the reduction of yellow on thorax, the propodeum being black, unstriped. The allotype is colored almost like the holotype. The female paratype has most of pronotum, scutellum and postscutellum, and a large spot in upper part of mesopleura chrome-yellow.

Holotype: San Antonio, Bexar Co., TEXAS, male (G. P. Engelhardt).—*Allotype*: Big Bend Park, Brewster Co., TEXAS, female or worker (Rollin H. Baker).—One female *paratype* with same data as allotype.—Types at Museum of Comparative Zoölogy, Cambridge, Mass. The male was selected as the holotype, being the only perfect specimen.

3. *P. major* var. *bonaccensis* J. Bequaert (1937, *op. cit.*, p. 174).—This form is known only from Bonacca Island, off the north coast of the Republic of Honduras. It is homeochromic with *P. carnifex* var. *ochreata* Spinola, which was also taken on Bonacca Island by Dr. M. Bates. On the neighboring island of Roatan he found only the typical form of *P. major*.

4. *P. major* var. *castaneicolor* J. Bequaert.—Known only from Mexico (State of Jalisco) and a few localities in southern New Mexico (Alamogordo) and in southern Arizona (Sabino Canyon, Sa. Cataline Mts.; etc.).

5. *P. major* var. *palmarum* J. Bequaert.—Known only from southeastern California and Lower California, Mexico (San José del Cabo).

Polistes fuscatus (Fabricius)

The most common North American species of the genus covers the entire United States and the southern areas of the Dominion of Canada, in southern Quebec, southern Ontario, southeastern Alberta and southern British Columbia (northernmost locality: Chilcotin, in about 52° N., farthest north for any American *Polistes*).³ It extends southward to Mexico, Guatemala and the Republic of Honduras; but its distribution is poorly known there. It has been introduced accidentally by man into the Bermudas, Jamaica, Barbadoes, the Society Islands and the Hawaiian Islands, where it is now more or less established. *Polistes fortunatus* Kirby, described from the Cape Verde Islands, appears to be one of the color forms of *P. fuscatus* (probably var. *nestor* Fabricius), imported by man from the New World. All published records of *P. fuscatus* from continental South America appear to be based upon a confusion with *P. pacificus* Fabricius, which is structurally very different.

³ There are as yet no records of *Polistes* from New Brunswick and Nova Scotia.

P. fuscatus is perhaps the most variable wasp in existence, with regard to color and also to certain structural characters (particularly the shape of the clypeus of the male). These matters will be discussed more fully later. In the present preliminary study, I have been as conservative as possible, retaining most of the forms named by my predecessors. I recognize eighteen varieties, sixteen of which occur in the United States; five are here described as new.

KEY TO COLOR FORMS OF *P. FUSCATUS*

The unusually wide range of variation of most color forms, or varieties, of *P. fuscatus*, makes it difficult to construct a workable key for their identification. Some of the varieties are placed twice in the key; but even this device will not take care of many transitional specimens, which must be named more or less arbitrarily. The key, moreover, is based on females (queens and workers) only. The males are always more extensively yellow than the corresponding females. They should either be bred or collected from nests or matched arbitrarily with the forms known to occur in the same geographical area.

1. Thorax (including mesonotum) predominantly bright yellow or orange-yellow, with narrow russet or blackish sutures; mesonotum sometimes with small ferruginous or blackish blotches. Abdomen and legs extensively or mostly yellow. Wings amber-yellow or infuscated and more or less purplish var. *flavus*.
 Thorax (at least mesonotum) predominantly black or light or dark ferruginous, often more or less marked with yellow 2.
2. Small forms of the Bahamas or of Central America. Very extensively yellow, particularly on the propodeum and first tergite. Fore wing 10 to 13 mm. long 3.
 Forms of the American continent, usually larger (except var. *hunteri*), much less extensively yellow; propodeum at most with narrow stripes 4.
3. Form of the Bahamas. Mesonotum with four yellow stripes. Most of second tergite yellow. Wings smoky and rather strongly purplish var. *maritimus*.
 Form of Central America. Mesonotum without yellow stripes. Second tergite mostly ferruginous. Wings yellowish-russet var. *neotropicus*.
4. Dark areas of thorax mainly black, without or with yellow or reddish markings 5.
 Thorax mainly light or dark ferruginous, with or without yellow or black markings 15.
5. Small form (fore wing 10 to 18 mm. long) of the southeastern United States. Thorax with at least pronotum and scutellum ferruginous;

- propodeum almost always with yellow stripes. Most tergites with yellow margins, the third and fourth usually extensively black. Wings slightly yellowish russet, more or less purplish in the radial cell var. *hunteri*.
- Larger (fore wing 15 to 20 mm. long) and of a different color 6.
6. Yellow markings scanty, often reduced to narrow hind margins on pronotum and one or more tergites; disk of second tergite without yellow lateral spots, the sides not or only narrowly yellow 7.
- Yellow markings extensive, at least on abdomen; disk of second tergite either with at least traces of lateral spots or extensively yellow on the sides 10.
7. Mostly black; thorax and second tergite without or with mere traces of ferruginous blotches; propodeum rarely with yellow stripes; legs black or more or less ferruginous, with the tarsi conspicuously yellow var. *pallipes*.
- Body and legs more or less ferruginous; either thorax or abdomen or both distinctly blotched with ferruginous (at least on second tergite) 8.
8. Abdomen mostly ferruginous; bases of tergites black, apices of one or more margined with yellow. Thorax more or less blotched with ferruginous; mesonotum as a rule uniformly black; propodeum often with yellow stripes var. *nestor*.
- Abdomen mostly black 9.
9. Large (fore wing 15 to 19 mm. long). Thorax rather extensively blotched with ferruginous; mesonotum either mostly ferruginous or with two ferruginous stripes. Abdomen either entirely black or first and second tergites (or one of them) more or less blotched with ferruginous. Yellow markings often almost lacking; propodeum without yellow stripes, usually extensively ferruginous; sometimes first tergite with yellow margin var. *metricus*.
- Medium-sized (fore wing 13 to 16 mm. long). Thorax not extensively ferruginous, often only with small blotches on pronotum; mesonotum as a rule uniformly black. Sides of second tergite and sometimes blotches on first, ferruginous. Yellow markings more or less developed; propodeum with or without yellow stripes; one or more tergites with yellow margins typical *P. fuscatus*.
10. Propodeum without yellow stripes; thorax mostly black. Second tergite black, with yellow margin and two large yellow lateral spots somewhat fringed with ferruginous; third to sixth tergites mostly yellow. Wings brownish-yellow; stigma and veins rufous var. *utahensis*.
- Propodeum with at least traces of longitudinal yellow stripes 11.
11. Yellow color extending over most of the tergites; lateral spots (particularly of second tergite) large, either broadly connected with the yellow sides and hind margins or separated by a narrow and usually faint line 12.

- Yellow color of abdomen restricted to sides and hind margins of tergites and two small, entirely free, lateral spots on some or all tergites (spots of first tergite sometimes lacking or connected with apical band) 14.
12. Head black and yellow only. Thorax not or scarcely marked with rufous. Black areas of second tergite as a rule not fringed with rufous. Wings amber-yellow; stigma and veins rufous
var. *aurifer*.
- At least head and often also pronotum blotched with rufous. Black areas of second tergite often more or less fringed with rufous 13.
13. Rufous color of thorax and abdomen extensive. Wings slightly smoky and more or less purplish; stigma and veins russet var. *apachus*.
- Rufous color either absent on thorax and abdomen or restricted to blotches on pronotum and fringes around the yellow areas. Wings yellowish-gray, very slightly or scarcely purplish; stigma and veins rufous var. *connectens*.
14. Black areas of second tergite either more or less replaced by rufous or broadly fringed with rufous. Pronotum and head usually much blotched with rufous. Wings smoky, markedly purplish; veins blackish, costa and stigma russet var. *variatus*.
- Black areas of second tergite not or barely fringed with rufous. Pronotum and head scarcely rufous. Wings yellowish-gray, very slightly purplish; stigma and veins russet-brown var. *montanus*.
15. Large (fore wing 18 to 22 mm. long). Almost wholly and uniformly light ferruginous; only first tergite with narrow yellow margin (sometimes lacking); propodeum and postscutellum sometimes marked with yellow. Wings purplish-black; stigma and veins black
var. *rubiginosus*.
- Not uniformly light ferruginous and often smaller, or else several tergites with yellow apical margins 16.
16. Thorax and head mainly light mahogany-brown, more or less blotched with black, practically without yellow markings. Abdomen mainly blackish, usually without yellow markings; first and second tergites often partly ferruginous; first tergite sometimes with narrow yellow margin. Large (fore wing 14 to 20 mm. long) var. *metricus*.
- Blackish color of abdomen not contrasting with the light reddish-brown of head and thorax. Yellow markings usually more extensive, particularly on the abdomen 17.
17. Abdomen very extensively yellow, often almost entirely so; second tergite either mostly yellow, or extensively yellow on the sides, or with two yellow lateral spots 18.
- Abdominal tergites only with apical yellow margins; second tergite without lateral yellow spots and not or only narrowly yellow on the sides. Wings slightly infuscated, somewhat purplish 20.
18. Yellow markings of thorax much reduced or almost lacking; mesonotum and propodeum without yellow stripes. Wings amber-yellow; stigma and veins russet. Large (fore wing 16 to 18 mm. long)
var. *centralis*.

- Yellow markings of thorax extensive; propodeum nearly always and mesonotum often with yellow stripes 19.
19. Small (fore wing 12 to 15 mm. long). Wings amber-yellow. (California) var. *anaheimensis*.
 Medium-sized or large (fore wing 15 to 18 mm. long). Wings slightly smoky and somewhat purplish. (Southern United States, from Arizona and Utah to Florida) var. *apachus*.
20. Yellow markings scanty and narrow, often reduced to hind margins of pronotum and of first tergite. Thorax mostly ferruginous, with blackish blotches on pleura and mesonotum; propodeum without or with narrow yellow stripes. Large or medium-sized (fore wing 15 to 20 mm. long) var. *nestor*.
 Yellow markings extensive on thorax and abdomen; as a rule most tergites broadly margined with yellow; propodeum almost always with broad yellow stripes 21.
21. Large (fore wing 15 to 20 mm. long). Black areas of abdomen absent or reduced to extreme bases of tergites var. *bellicosus*.
 Smaller (fore wing 10 to 18 mm. long). Third and fourth tergites usually extensively black var. *hunteri*.

1. *P. fuscatus*, typical.—Specimens agreeing in every detail with Fabricius' description and type, now at the University Museum in Kiel,⁴ are by no means common. They are occasionally found, together with various slight variants, in southern Massachusetts (for instance, on Cape Cod and Martha's Vineyard), Rhode Island, Connecticut, southern New York (particularly Long Island), New Jersey, Pennsylvania, Virginia, West Virginia, North Carolina (Southern Pines; Raleigh), Ohio (Columbus; Cleveland), Illinois (Havana), Michigan, Indiana (Bloomington), southern Iowa (Decatur Co.), and eastern Kansas (Blue Rapids). I have not seen typical *fuscatus* from Canada, and what has been recorded from there under that name was probably all somewhat aberrant var. *pallipes*. Moreover, it intergrades with var. *nestor* and var. *pallipes*, as it covers some of the territory of both. It is particularly hard to draw a line between typical *fuscatus* and var. *nestor*, and it might be more rational to unite these two, at any rate.

2. *P. fuscatus* var. *anaheimensis* Provancher.—This color form is peculiar to California, where it occurs as far north as 38° N. latitude.

⁴ Dr. Olaw Schröder kindly compared a series of North American specimens with Fabricius' type.

3. *P. fuscatus* var. *apachus* de Saussure.—*P. texanus* Cresson I regard as a synonym. This form is common in Texas, western Oklahoma (Woodward Co.; Grand), New Mexico, Arizona, southwestern Colorado and southern Utah; occasionally elsewhere (Henry Co., southeastern Iowa; Ft. Lauderdale, Florida). I have also seen it from the States of Sonora and Coahuilla, Mexico.

4. *P. fuscatus* var. *aurifer* de Saussure.—The common form of the species throughout California, Oregon and the State of Washington. It extends well into southern British Columbia (Vernon; Kaslo; Chilcotin), as well as into Idaho (Warren, Idaho Co.; Waha; Coeur d'Alène) and Nevada (Humboldt River). This wasp was introduced into the Hawaiian Islands many years ago (first published record in 1884, by W. F. Kirby) and in 1928 it was reported from the Society Islands.

5. *P. fuscatus* var. *bellicosus* Cresson.—A common form of the southeastern United States, which, however, does not extend as far north as *metricus*. I have seen it commonly from South Carolina (Dewees Id.), Florida, Alabama, Mississippi, Louisiana and Texas. It intergrades with var. *apachus*.

6. *P. fuscatus* var. *centralis* Hayward, 1933, Proc. Utah Ac. Sci., X, pp. 141 and 143, Pl. IX, fig. 13.—This form appears to be restricted to Utah and western Colorado. In southern Utah it intergrades with *apachus*.

7. *P. fuscatus* var. (or subsp.) **connectens**, new.

Female and Worker.—Head mostly yellow; vertex, occiput, a broad, hour-glass-shaped spot about the antennae, and outer half of outer orbits, black; clypeus medially and outer orbits somewhat suffused with russet; antennae ferruginous, flagellum somewhat infusate above, scape with black spot near upper tip. Thorax mostly black, with a few rufous blotches on dorsal areas of pronotum and on scutellum and postscutellum, variable in extent; narrow fore and hind margins of pronotum, scutellum and postscutellum anteriorly, two broad median stripes and lateral spots on propodeum, and a spot on mesopleura beneath base of wing, yellow; sometimes two yellowish or russet longitudinal stripes or lines on mesonotum; tegulae russet, spotted with yellow. Legs mostly ferruginous; coxae black, streaked with yellow; femora, tibiae and tarsi more or less yellow on the outer side. Abdomen extensively yellow; a black spot, irregularly hourglass-shaped, in basal two-thirds of first tergite, more or less edged with ferruginous; a larger hourglass-shaped black spot over basal three-quarters of second tergite more or less edged with ferruginous which often forms spots at the extreme sides basad of the yellow; and median, irregularly quadrate black spots at base of succeeding tergites,

often partly ferruginous; the sternites are black with broad yellow apical margins and lateral spots. Wings subhyaline, suffused with amber-yellow; veins russet.

Male.—Sometimes similar to the female, though with the face more extensively yellow, without black about the antennæ; mesosternum and entire under side of coxæ yellow. Other males are more extensively ferruginous, being then hardly separable from those of var. *variatus*.

Holotype: Badlands west of Grassy Butte, McKenzie Co., western NORTH DAKOTA, female (N. A. Weber).—*Allotype*: same locality, male (N. A. Weber).—*Paratypes*: ALBERTA: Medicine Hat, several females and males (F. S. Carr; E. H. Strickland); Lethbridge (E. H. Strickland); Mayberries (E. H. Strickland).—NORTH DAKOTA: Badlands west of Grassy Butte; Junction of Cannonball and Missouri Rivers, Sioux Co. (N. A. Weber); Medora, one male (O. A. Stevens); Fargo (O. A. Stevens); Mandan (O. A. Stevens); Medora (C. H. Waldron); Sentinel Butte (O. A. Stevens); Mott (J. R. Campbell); Marmarth (O. A. Stevens); Beach (R. L. Webster); Hague (M. van Soest); Trottem (A. C. Fox).—MONTANA: Laurel, Yellowstone Co.—WYOMING: Torrington, Goshen Co. (G. B. Fairchild).—NEBRASKA: Squaw Canyon, Sioux Co. (H. G. Barber); Lodgepole, 4,050 ft., Cheyenne Co. (H. A. Scullen).—COLORADO: Texas Creek, (J. C. Bradley); Denver (J. Bequaert); Manitou (J. Bequaert); Clear Creek, 7,000 to 8,000 ft., Jefferson Co. (G. P. Engelhardt); vicinity of Fort Collins (23 mi. up Little Poudre Canyon and Spring Canyon) (A. B. Klots); Boulder (E. R. Becker); Boulder Co. (C. P. Custer); Berkeley.—*Holotype*, *allotype* and several *paratypes* at Museum of Comparative Zoölogy, Cambridge, Mass. *Paratypes* also in several other collections.

This color form seems to be characteristic of the northwestern portion of the Upper Sonoran life zone. It probably will be found also in parts of South Dakota and Kansas. Its occurrence in southeastern Alberta is of considerable interest.⁵ The region is apparently an Upper Sonoran island surrounded by Transition fauna. Professor Strickland informs me that several other southern insects have been taken there. The solitary wasps he sent me include *Odynerus annulatus* var. *geminus* Cresson, *O. anormis*

⁵ A female of the var. *connectens* was also taken on a window pane in a house at Edmonton, Alberta. This was certainly an accidental importation by man. No *Polistes* was ever found in the open in that vicinity.

Say, *O. aldrichi* Fox, *O. dorsalis* (Fabricius), *Pterochilus quinquefasciatus* Say, and *P. decorus* Cresson.

The var. *connectens* is clearly transitional between the var. *aurifer* and the var. *variatus*, and shows also some gradation to the varieties *apachus*, *montanus* and *utahensis*. It is most typical in North Dakota.

At Medicine Hat females were taken in flight during August and September and males early in September. On November 27 a female was found hibernating "under clod." On April 17 a female was caught at the flowers of Buffalo Berry, *Lepargyræa canadensis* (Linnæus).

8. *P. fuscatus* var. *flavus* Cresson.—This is the extreme xanthic variation of the species, common in Arizona, southern Nevada (Las Vegas, Clark Co.), southern Utah (St. George, Washington Co.; Hurricane, Washington Co.), parts of New Mexico (Rio Grande Canyon, south of Taos; Highrolls; Picacho), and western Texas (Devils River near Comstock, Valverde Co.; Big Bend Park, Brewster Co.). It should also occur in northern Mexico, but I have as yet seen no Mexican specimens. Evidently characteristic of the Lower Sonoran desert country, it intergrades to some extent with var. *apachus*.

9. *P. fuscatus* var. (or subsp.) *hunteri*, new.

Average size smaller than most other forms of *P. fuscatus*. Length (h. + th. + t. 1 + 2), of female and worker, 10 to 12 mm.; of male, 10 to 12 mm. Length of fore wing, of female, 10 to 13 mm.; of male, 10 to 13 mm.

Female and Worker.—Variegated black and reddish-brown in fairly equal proportions and with many bright yellow markings. Head mostly reddish-brown, with the ocellar area of the vertex and hind face of occiput black, the upper side of scape and of most of flagellum fuscous, but the flagellum not ringed with black. Thorax black, with the pronotum mostly, four longitudinal stripes on mesonotum, and most of scutellum and postscutellum, reddish-brown; sometimes most of the mesonotum and blotches on mesopleura and sides of propodeum reddish; or the mesonotum entirely black. Abdomen: first and second segments mostly reddish-brown, usually with blackish base extending triangularly behind; third and fourth more brownish-black to black, turning reddish posteriorly near the yellow hind borders; fifth and sixth reddish-brown to black. Legs mostly reddish brown, with black coxæ and infusate bases of femora and apical half of hind tibiæ; tibial spurs ferruginous. Yellow markings as follows: broad apical margin of clypeus; lower inner orbits; entire outer orbits; narrow collar and hind margin of pronotum; broad anterior fasciæ on scutellum and postscutellum; a large spot on mesopleura

beneath base of fore wing; most of tegulæ; two broad longitudinal stripes and valvulæ of propodeum; broad apical margins of all tergites and most sternites (usually narrowed or interrupted medially on the sternites); lateral streaks or spots on first tergite, more or less connected with the apical band; apices of femora, outer side of tibiæ and most of tarsi. Wings moderately yellowish-russet, somewhat darker and slightly purplish over the radial cell; veins and stigma russet.

Male.—Similar to the female, but the yellow usually more extensive, covering most of the face, the entire clypeus, the oculo-malar spaces and most of outer orbits, the mandibles, the under side of the scape, most of the prosternum and under side of coxæ and femora.

Holotype: Paradise Key, Dade Co., FLORIDA, female (Richard Dow).—*Allotype*: Cape Sable Road, 5 mi. W. of Dade Co. Line, FLORIDA, male (Richard Dow).—*Paratypes*: VIRGINIA: Falls Church.—OHIO: Hocking Co.—NORTH CAROLINA: Southern Pines; Statesville; Raleigh; Wilmington; Morgantown; Kittrell; Kingsboro; Laurinbur; Havelock (Lake Ellis); Wadesboro; Conove; Aberdeen; Willard; Liberty; Ft. Bragg; Winston-Salem; Boardman; Fairmont.—SOUTH CAROLINA: Clemson College.—GEORGIA: Billy's Id., Okefeenoke Swamp; Roswell.—FLORIDA: Matecumbe Key; Monticello; Paradise Key; Ft. Lauderdale; Gulfport; Tampa; Tamiami Trail, Dade Co.; St. Petersburg; Jacksonville; Stuart; Miami; Kelsey City; West Lake, Dade Co.; Lutz; Clearwater; Titusville; Biscayne Bay; Charlotte Harbor; Gainesville; Key Largo; Lower Matecumbe Key; Orlando; Cape Sable; Coconut Grove; Crescent Grove.—ALABAMA: Thomasville, Clark Co.; Mobile; Leroy, Washington Co.; Biloxi; Auburn; Greenville.—MISSISSIPPI: Oxford; Winona.—LOUISIANA: Shriever, Terrebonne Co.; Darrow, Ascension Co.—TEXAS: Williamson Co.; New Braunfels; Dallas; Richmond, Fort Bend Co.; Carniso Springs; College Station (as prey of a robber fly).—OKLAHOMA: Quinton, Pittsburg Co.; Nowata Co.—MEXICO: Mexico, D. F.; Guadalajara, State of Jalisco; San Luis (de Potosi?); Cuernavaca, State of Morelos; Valle del Murz.—*Holotype*, *allotype* and many *paratypes* at Museum of Comparative Zoölogy, Cambridge, Mass.; *paratypes* also in several other collections.

This wasp is one of the most common insects of the southeastern United States. It looks like a diminutive var. *bellicosus*, with which it intergrades. In most cases it is readily distin-

guished from *bellicosus* by the small size and the predominance of black on the third and fourth tergites. Although the smallest *hunteri* are superficially very different from the other forms of *fuscatus*, they have all the structural characters of the species. In particular, the males always bear a minute tubercle on the middle of the seventh sternite. In addition it passes gradually into the var. *bellicosus*, so that some specimens must be placed arbitrarily. Some specimens of *hunteri* also resemble *P. exclamans* in color, but that species is structurally quite distinct (as shown in the key). In American collections and publications, this wasp is frequently called *Polistes minor*; but Palisot de Beauvois' wasp of that name came from Santo Domingo and it is structurally quite a distinct species from *P. fuscatus*.⁶

10. *P. fuscatus* var. (or subsp.) **maritimus**, new.

Female or Worker.—Head: most of face, vertex and occiput ferruginous, somewhat black around the ocelli and over a narrow streak on the vertex; clypeus, lower inner orbits into the ocular sinuses, oculo-malar space, cheeks (except in upper hind area) and mandibles, yellow; scape mostly and under side of flagellum ferruginous, upper side of flagellum black. Thorax: pronotum, scutellum, postscutellum and propodeum almost entirely yellow; pronotum and scutellum with small, dark ferruginous blotches; propodeum with a narrow, longitudinal black streak in the median groove; meso- and metapleura black with a series of yellow spots; sternum black; mesonotum black with four narrow, longitudinal yellow stripes, two median extending nearly the whole length, one short on each side above the tegula; tegula yellow with a ferruginous spot. Legs yellow, streaked with ferruginous along femora and tibiæ, the hind tibiæ more infuscated; tarsi ferruginous orange. Abdomen mostly yellow, with the following blackish or dark ferruginous markings: a small, basal, irregular spot on first tergite; narrow bases of most of the segments (more blackish on second and more ferruginous on remainder), that of second tergite expanding laterally and produced medially into an hourglass-shaped spot with three narrow apical projections; faint ferruginous lines set off yellow lateral spots from the apical margins on second to fifth tergites; sixth segment mostly ferruginous. Wings strongly infuscated, with pronounced purplish reflection, stigma and costa from base of wing to stigma, russet; remainder of veins black. Length (h. + th. + t. 1 + 2): 11 mm.; of fore wing, 12 mm.

Male unknown.

Holotype: Mangrove Cay, Andros Island, BAHAMAS, female,

⁶ The name *hunteri*, which I have adopted for this wasp, had been given to it in manuscript, at the U. S. National Museum, presumably by Ashmead.

May-June 1917 (Wm. M. Mann).—Type at Museum of Comparative Zoölogy, Cambridge, Mass.

Apparently a small insular form related to var. *hunteri*, of the southeastern United States, but much more extensively marked with yellow. It resembles superficially the West Indian *P. poeyi* Lepeletier and true *P. minor* Palisot de Beauvois. From the former it differs in the presence of the mesepisternal suture and the stronger striæ of the propodeum; from the latter in the shape of the clypeus and the striation of the propodeum. Since the male is as yet unknown, the var. *maritimus* is only tentatively placed under *P. fuscatus*.

11. *P. fuscatus* var. *metricus* Say.—There is a possibility that this wasp was described before Say as *Vespa geniculata* Gravenhorst (1807, Vergleichende Uebersicht Linn. u. einiger neuern Zool. Syst., p. 276; without locality). Until the type can be examined critically, I hesitate to adopt the name.—This form is common in the southeastern and central United States. I have seen it from New Jersey (Cape May), South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, eastern Texas (Williamson Co.; Brazos Co.; Dallas; Weslaco), Oklahoma, Arkansas, Tennessee, Missouri, Kentucky, southern Ohio (Pickaway Co.; Perry Co.; Hocking Co.; Buckeye Lake, Licking Co.), southern Indiana, Illinois (Chicago; New Columbia; Putnam; Urbana), Iowa (Mt. Pleasant), and Nebraska (Lincoln; Waverly). It should occur also in eastern Kansas. The distribution is much the same as that of *P. canadensis* var. *annularis*, which is more or less homeochromic and sometimes confused with it. The var. *metricus* extends much farther north in the valleys of the Mississippi, Missouri and Ohio than along the eastern seaboard. In certain areas it intergrades with other forms, particularly with var. *nestor*.

12. *P. fuscatus* var. (or subsp.) **montanus**, new.

Female and Worker.—Closely related to var. *utahensis* Hayward, from which it differs mainly in the presence of yellow stripes on the propodeum. Head: mostly black; lower third and broad sides of clypeus, lower inner orbits up to ocular sinuses, two streaks above bases of antennæ, a spot on upper outer corner of oculo-malar space, and much of mandibles, yellow; middle and upper part of clypeus (except the upper margin), blotches on oculo-malar space, a narrow streak on outer orbit, ocular sinuses, margins of

mandibles (except the black teeth), and antennæ (except a black streak on upper side of scape), ferruginous. Thorax: black; tegulæ ferruginous, spotted with yellow; narrow anterior and posterior margins of pronotum, two small spots near anterior margin of scutellum, narrow anterior margin of postscutellum, a short vertical streak in upper part of mesopleura (beneath base of wing), and two longitudinal stripes on propodeum (variable in extent, sometimes barely indicated), straw yellow; none of the specimens seen have any ferruginous on the thorax. Legs black; extreme apices of femora ferruginous on hind legs, ferruginous and yellow on fore and mid legs; fore and mid tibiæ ferruginous with yellow outer streak; hind tibiæ black, blotched with ferruginous and with yellow outer streak; tarsi mostly yellow, ferruginous toward apices; tibial spurs and claws ferruginous. Abdomen: mostly black; moderately large apical margins of tergites 1 to 5 and sternites 2 to 4 (somewhat wavy and more or less interrupted medially) and free spots of moderate size and irregular shape on the sides of tergites 1 to 5 (very small and sometimes absent on first tergite), placed rather close to hind margins, straw yellow; sixth segment ferruginous, the tergite with two small, basal yellow spots; the black of the fifth tergite is usually tinged with ferruginous and that color may in some specimens surround more or less the free yellow spots of the other tergites. Wings moderately infuscated, with a yellowish tinge and marked purplish reflection, especially in the apical third; veins dark brown; stigma and costa from base of wing to stigma, russet.

Male.—Differs only slightly from the other sex, with which it is readily associated. As usual, the yellow color covers the entire clypeus, face and oculo-malar spaces, and most of the under side of thorax, legs and abdomen; the upper side of thorax and abdomen are as in the female.

Holotype: Hamilton, Ravalli Co., MONTANA, female (W. J. Jellison).—*Allotype*: same locality, male (W. J. Jellison).—*Paratypes*: MONTANA: Hamilton, several females (W. J. Jellison); Ravalli Co., one female (W. J. Jellison); Willow Creek, Ravalli Co., four females (W. J. Jellison); Blodgett Canyon, Ravalli Co., one female (W. J. Jellison); Burch Creek, Ravalli Co., one female (W. J. Jellison); Lake Ronan, Lake Co., one female (R. D. Eichmann); Baird, Missoula Co., one female (A. L. Melander).—IDAHO: Wallace, Shoshone Co., one female; Pine Creek, Shoshone Co., 2,600 ft., one female.—OREGON: Corvallis (J. Schuh); 23 mi. W. of Halfway, 4,700 ft. (R. E. Rider); Pine Creek Canyon, 4,600 to 5,300 ft., Baker Co. (R. E. Rider); Umatilla, Umatilla Co., two females.—Holotype, allotype, and several paratypes at the Museum of Comparative Zoölogy, Cambridge, Mass.; paratypes also in several other collections.

Like the var. *utahensis*, this is an extreme variant of var. *aurifer*, seemingly connecting the two. In Oregon, where it occurs in certain localities together with *aurifer*, intergrades are also met with. As it appears to be the dominant color form of the species in Montana, it would seem to deserve a name.

13. *P. fuscatus* var. (or subsp.) **neotropicus**, new.

Closely related to var. *hunteri*, of which it has about the size, but more extensively marked with yellow, the propodeum being almost entirely of that color.

Female and Worker.—Head and antennæ ferruginous-red, the vertex more or less blackish about the ocelli; flagellum somewhat infusate above; clypeus as a rule entirely, broad lower inner orbits (as far as ocular sinuses), oculo-malar spaces, broad outer orbits and most of mandibles, pale yellow. Thorax ferruginous-red on pronotum and mesonotum, black on sternum and pleura (the mesonotum rarely more or less black); broad fore and hind margins of pronotum, tegulæ, small spots on sides of mesonotum, most of scutellum and postscutellum, two spots on the mesopleura (one above the other), and most of propodeum (except a narrow median black line and broader black sides), yellow. Abdomen ferruginous-red dorsally, at most slightly infusate at the base of the third and fourth tergites, ventrally blackish-brown; apex and sides of first tergite very extensively (leaving only a ferruginous oval patch in the center), apical margins of succeeding tergites (narrow medially, much widened laterally and continued along the sides of the second tergite) and narrow spots in the hind corners of second and third sternites (sometimes continued as a complete apical margin on second sternite), yellow; sixth segment entirely ferruginous. Legs black, blotched with ferruginous; apical fourth to half of femora above, most of fore and mid-tibiæ, basal two-thirds of hind tibiæ, and most of tarsi, yellow; tibial spurs ferruginous. Wings moderately tinged with yellowish-russet, somewhat darker and slightly purplish over radial cell; veins and stigma russet.

Male.—Similar to the female, with which it is readily associated. Yellow more extensive on the legs, the under side of fore and mid coxæ being mostly of that color. Two yellow spots on sternum.

Length (h. + th. + t. 1 + 2), of female and worker, 10 to 12 mm.; of male, 11 to 12 mm. Length of fore wing, of female and worker, 10 to 13 mm.; of male, 11.5 to 13 mm.

Holotype: Puerto Castilla, REPUBLIC OF HONDURAS, female (J. Bequaert).—*Allotype*: Prieta, REPUBLIC OF HONDURAS, male (J. Bequaert).—*Paratypes*: Puerto Castilla, three females; Prieta, one female.—GUATEMALA, without more definite locality, five females and two males.—All types at Museum of Comparative Zoölogy, Cambridge, Mass.

14. *P. fuscatus* var. *nestor* (Fabricius).—This form is more extensively ferruginous over the abdomen than typical *fuscatus*, with which it intergrades. It is found occasionally on Long Island (New York) and in New Jersey, more commonly in southern Pennsylvania, Maryland, Virginia, North Carolina, South Carolina, Georgia, Florida (Tangerine; Monticello), Alabama (Mobile), Kentucky, eastern Texas, southern Michigan (Midland Co.), southern Illinois (New Columbia; Herod), Indiana (Bloomington) and Ohio. There are many intergrades not only with typical *fuscatus*, but also with the var. *variatus*. All specimens I have seen from the Bermudas, Jamaica and Barbadoes were of the var. *nestor*, rather than typical *fuscatus*.

15. *P. fuscatus* var. *pallipes* Lepeletier.—*P. exilis* de Saussure appears to be a synonym. It is the extreme melanistic form of the species, characteristic of the northeastern part of the range, throughout the Transition life zone. I have seen it from southern Quebec (St. Jerome; Montebello; La Trappe; Montreal; Rigaud; Outremont; St. Remy; Queen's Park, Aylmer), southeastern Ontario (Frank' Bay, Lake Nipissing; Gull Lake; Pelee Id.), Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut (Colebrook), New York (including Staten Island and Long Island), New Jersey, Pennsylvania (Bartonsville; Pittsburgh; Braddock; Green Lane, Montgomery Co.; Mauch Chunk), West Virginia, Maryland (Plummers Id.), Ohio (Mahony Co.; Marietta), Indiana (Winona Lake), Illinois, Michigan (common), and northern North Dakota (Towner). It will probably also be found in Wisconsin and Minnesota. The northernmost locality is Towner, in about 48° 30' N. In the southern part of the range it intergrades with *nestor* and typical *fuscatus*. The extent of pale yellow markings varies greatly. Some specimens have only a narrow apical margin on the first tergite, narrow margins on the pronotum, the tegulae and two lines on the propodeum of that color. There are all passages to the other extreme, with broad apical margins on all tergites (often continued along the sides), yellow margins of pronotum, scutellum and post-scutellum, two broad stripes on propodeum (in one case even four stripes), a spot on mesopleura, and markings on the head. A few specimens may even show small, free, yellow lateral spots on the second tergite, thus simulating var. *variatus* and var.

montanus; they lack, however, the rufous blotches of the former and the yellowish-gray wings of the latter.

16. *P. fuscatus* var. *rubiginosus* Lepeletier.—*Vespa nigripennis* Degeer (1773) may have been this wasp, and if this is the case, Degeer's name will take precedence over Lepeletier's. This is a common wasp of the southeastern United States. I have seen it from southern Ohio (Blue Creek; Adams Co.; Lawrence Co.), Pennsylvania (Coraopolis), Virginia (Fredericksburg), North Carolina (Raleigh; Southern Pines), South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, eastern Texas (Comal Co.; Fort Bend Co.; Brazos Co.; Bastrop Co.; Kaufman Co.; College Station; Williamson Co.; San Antonio; New Braunfels; Austin), Arkansas, Oklahoma, Missouri, Kentucky, Tennessee, and southern Illinois (Olive Branch). It is better defined than other color forms of the species and shows little intergradation.

17. *P. fuscatus* var. *utahensis* Hayward, 1933, Proc. Utah Ac. Sci., X, pp. 141 and 142, Pl. IX, figs. 1 and 3-9.—This color form is known from Utah, Idaho, Nevada, Colorado, and Wyoming (Lava).

18. *P. fuscatus* var. *variatus* Cresson.—This is a fairly common form of the species in the Middle West: North Dakota (Fargo; Sheldon), Minnesota (Sleepy Eye), Nebraska (Lincoln; Cambridge), Iowa (common), Kansas (Manhattan; Wathena; Hays), Missouri, Illinois, Indiana, southern Michigan (common), Ohio, Kentucky (Buckeye; Mammoth Cave), Tennessee, Arkansas (Spring Dale), Oklahoma (Stillwater; Woodward Co.; Grand) and eastern Texas. I have also seen a few specimens from southern New Jersey (Lakehurst) and New Mexico (Carlsbad). In the northern parts of its range it intergrades with var. *nestor*, in Iowa with typical *fuscatus*, and in Texas and Oklahoma with var. *apachus*. Hayward's records of *variatus* from Canada (1933, Canad. Entom. LXV, p. 128) were, I believe, all due to a confusion with other forms of the species. Those from British Columbia referred to var. *aurifer*; the one male from Medicine Hat, Alberta, was my var. *connectens*; and the one male from Nelles Corner, Ontario, probably an aberrant var. *pallipes*. It is nevertheless, possible that the var. *variatus* may yet be found in southern Ontario.

Postscript

The following remarks may prevent needless criticism. (1) For want of space it was not possible to enumerate the many museums and private collectors to whom I am deeply indebted for material or other assistance. (2) For the same reason the distribution of most forms is given by States only, except for the new and rare forms, or when more definite localities may help to define the geographical limits. (3) Structural characters could not now be illustrated nor their variation discussed. (4) More in particular, the male terminalia are not mentioned, because the specific differences they show are slight and could not be described adequately without figures.



Bequaert, Joseph C. 1940. "An Introductory Study of Polistes in the United States and Canada with Descriptions of Some New North and South American Forms (Hymenoptera; Vespidae)." *Journal of the New York Entomological Society* 48, 1–31.

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