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PODALONIA (HYMENOPTERA: SPHECIDAE) OF NORTH AND CENTRAL AMERICA* †

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INTRODUCTION

The North American wasps of the genus *Podalonia* were monographed in 1927 by H. T. Fernald. In this work Fernald noted several problems which were still unsolved. One problem centered around *luctuosa*. Over 350 specimens of *luctuosa* were examined, but only one male which could be considered to belong to this species was seen. One mated pair came to the attention of Fernald. The female of this pair had the black abdomen of *luctuosa*, but the male had the red and black abdomen of *violaceipennis*. As a possible explanation, Fernald proposed the theory that the female *violaceipennis* is sometimes dimorphic, *luctuosa* being one of these forms, and that in rare instances the male also becomes entirely black. As a conclusion, Fernald stated: "On the whole it seems best to leave *luctuosa* as a species separate from *violaceipennis*, for the present, until more pairs have been captured and the evidence they may give becomes available."

In 1931 Fernald believed he had sufficient evidence to conclu-

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sively place *luctuosa* as one of the forms of the dimorphic species *violaceipennis*. His evidence was: two mated pairs, in both cases the female with the abdomen black but the male with the abdomen red and black; a reared male. The reared specimen was reported to Fernald by Walter Carter. Carter observed several female *luctuosa* digging and storing their nests. He marked these nests and later collected three or four cocoons from them. From one of these cocoons there emerged a red and black male.

Other problems still to be solved concerned several species of uncertain position. Additional evidence was needed before the position of these species, namely, *jason* (Cam.), *mexicana* (Saus.), *morrisoni* (Cam.) and *piceiventris* (Cam.), could be determined with certainty.

The writer, on examination of wasps determined as *luctuosa* in the University of Minnesota collection, discovered that this species had been collected commonly in the northern part of Minnesota but never in the southern part of this state. In view of the value of the study of male genitalia in separating closely related species, the writer desired to undertake a critical study of these structures in the species of this genus. When the genitalia of a long series of males determined as *violaceipennis* were examined, it was found that they were not all alike. One type was quite distinct from all the others. The males which possessed this type were placed together, and, of the specimens collected in Minnesota, it was at once apparent that every one had been taken in the northern part of the state.

The remarkable correlation between the collecting data of *luctuosa* and the series of males whose distribution in Minnesota was limited to the northern part of the state, and the distinctness of the male genitalia of this series as compared with the genitalia of other specimens determined as *violaceipennis*, raised the question as to whether *luctuosa* was one form of a dimorphic species or whether it was a distinct species the male of which had never been determined. Through the courtesy of Dr. J. Bequaert and Mr. C. F. W. Muesebeck, the writer was able to examine the specimens of *luctuosa* reported by Fernald as having been taken in mating. A study of these showed that, contrary to Fernald's conclusion, the genitalia of the males were quite distinct and separable from the genitalia of *violaceipennis* males. A comparison of figures 1 and 16 makes this evident. In view of these findings, the writer believed it would be desirable and worthwhile to make an exhaustive study of the genus *Podalonia* and to prepare a revision of this genus.

METHODS AND MATERIALS

The male genitalia in the genus *Podalonia* are usually hidden by the abdominal segments. To extract the genitalia, the specimen is relaxed in a jar containing a liberal amount of relaxing fluid. The relaxing fluid which proved to be very satisfactory is a mixture of equal parts of ethyl acetate, 95% ethyl alcohol, and distilled water. A drop of this fluid is placed on the tip of the abdomen to assist in the softening of the genitalia and the posterior abdominal segments. When the specimen is sufficiently relaxed, it is removed from the relaxing jar and an insect pin is inserted into the abdomen immediately ventrad of the genitalia. This is to insure a slight opening. Another insect pin, the tip of which has been bent to form a hook, is inserted into this opening, and with the aid of the hook the genitalia are extracted.

Since the genitalia are usually rather heavily sclerotized, it is desirable to clear them in potassium hydroxide in order to see easily some of the structures. When sufficiently cleared, they are washed in distilled water and placed in a small vial containing glycerine. This vial is then placed on the same pin as the specimen from which the genitalia are extracted. When it is desired to make a study of the genitalia, they are removed from the vial and placed in a small watch glass containing distilled water.

Approximately 5050 specimens have been examined in the course of this study. The writer has examined the holotypes of the following species: *communis* (Cresson), *pacifica* (Melander & Brues), *nicholi* (Carter), *valida* (Cresson), *robusta* (Cresson), and *argenteifrons* (Cresson). The allotypes of *valida* (Cresson) and *grossa* (Cresson), and paratypes of *alpestris* (Cameron), *atriceps* (Smith) ♂, *montana* (Cameron), *jason* (Cameron), and *compacta* Fernald have also been examined. Through the courtesy of Dr. J. Carl of the Museum of Natural History of Geneva, a male and a female of the type series of *mexicana* (Saussure) have been examined and designated as lectotype and lectoallotype respectively. Dr. R. B. Benson made comparisons with the following types located in the British Museum (Natural History): *luctuosa* (Smith), *alpestris* (Cameron), *piceiventris* (Cameron), *montana* (Cameron), *jason* (Cameron), *quadridentata* (Cameron), *sonorensis* (Cameron), *cementaria* (Smith) and *atriceps* (Smith) ♂. The only types not seen by either Dr. Benson or the writer are *violaceipennis* (LePele-tier), *morrisoni* (Cameron) and *atriceps* (Smith) ♀. *Violaceipennis* was described from Philadelphia, and since only one species of *Podalonia* has ever been taken in this vicinity, that species receives

the name *violaceipennis*. The holotype male of *morrisoni* has apparently been lost. The male genitalia of *morrisoni* are figured by Cameron, and the drawing compares favorably with specimens examined by the writer (see note below on Cameron's drawings). The holotype female of *atriceps* has apparently been lost, but the description indicates strongly that it is not a *Podalonia* but a *Sphex*. Some doubt must be placed on two of Cameron's species, *quadridentata* and *piceiventris*. In the taxonomic part of this paper each of these species has been placed in synonymy with another species, *quadridentata* with *montana* and *piceiventris* with *communis*. However, each of these species varies from the typical and because of the lack of specimens other than the holotypes it is not possible to decide definitely on their validity as distinct species.

A note is necessary here regarding the figures of male genitalia in Cameron's work on Central American species. The legends for some of these drawings have apparently been incorrectly associated with the figures. The clue that such a possibility exists was found in the drawings of *morrisoni* and *montana*. *Morrisoni*, as determined by the writer from the original description, has a strong tooth at the base of each penis valve. It is the only species of this genus in the New World having this tooth. But Cameron's figure of *montana* shows this tooth while his figure of *morrisoni* does not show it. The figure of *morrisoni* resembles closely the genitalia of *montana*, and so it becomes apparent that the legends for these two species have been reversed. Cameron's figure of *Ammophila varipes* has sagittae resembling those of *Podalonia* and entirely different from *Sphex*. Further, the penis valvae and the sagittae closely resemble those structures as they occur in *communis* or *communis* subspecies *alpestris*. It thus seems that this drawing with the legend *Ammophila varipes* is actually a figure of *Podalonia communis* subspecies *alpestris*. The drawing with the legend *alpestris* is almost certainly that of *luctuosa*, judging from the penis valvae and sagittae. Where Cameron obtained the specimen cannot be determined at present. The writer has not seen any specimens of *luctuosa* which were collected south of the United States, and if this species does occur in Mexico or Central America it must be exceedingly rare.

Detailed data for the specimens studied during the preparation of this revision are recorded and deposited in the library of the University of Minnesota. Because of the need for economy, detailed data for the commoner species have been omitted from this paper. Where they are included, the present location of each specimen is indicated in brackets following the citation of other data concerning

the specimen. Initial letters are used to designate institutional and individual collections as follows:

- AES—American Entomological Society, Philadelphia Academy of Sciences, Philadelphia, Pa.
- AMNH—American Museum of Natural History, New York, N. Y.
- BM—British Museum (Natural History), London, England.
- CAS—California Academy of Sciences, San Francisco, Calif.
- CH—Dr. C. H. Hicks, Burbank, California.
- CNM—Canadian National Museum, Ottawa, Canada.
- CS—Colorado State College, Fort Collins, Colorado.
- CU—Cornell University, Ithaca, New York.
- HF—Dr. H. T. Fernald, Winter Park, Florida.
- INHS—Illinois State Natural History Survey, Urbana, Ill.
- IWC—Iowa Wesleyan College, Mount Pleasant, Iowa.
- JB—Dr. Joseph Bequaert, Harvard School of Tropical Medicine, Boston, Mass.
- KS—Dr. K. S. Salman, Berkeley, California.
- KSC—Kansas State College, Manhattan, Kansas.
- KU—Kansas University, Lawrence, Kansas.
- MC—Massachusetts State College, Amherst, Mass.
- MCZ—Museum of Comparative Zoology, Cambridge, Mass.
- MHNG—Museum d'Histoire Naturelle de Genève, Geneva, Switzerland.
- MSC—Montana State College, Bozeman, Montana.
- OAC—Oregon Agricultural College, Corvallis, Oregon.
- OAMC—Oklahoma Agr. & Mech. College, Stillwater, Oklahoma.
- OS—Dr. O. A. Stevens, Fargo, North Dakota.
- OSU—Ohio State University, Columbus, Ohio.
- RB—Mr. R. H. Baker, College Station, Texas.
- RD—Dr. Richard Dow, Boston, Mass.
- RMB—Mr. R. M. Bohart, University of California, Los Angeles, California.
- ROMZ—Royal Ontario Museum of Zoology, Toronto, Ontario, Canada.
- RR—Mr. R. R. Dreisbach, Midland, Michigan.
- SD—South Dakota State College, Brookings, South Dakota.
- UA—University of Alberta, Edmonton, Alberta, Canada.
- UAES—Utah State Agricultural College, Logan, Utah.
- UBC—University of British Columbia, Vancouver, British Columbia.
- UC—University of Colorado, Boulder, Colorado.
- UM—University of Minnesota, St. Paul, Minnesota.

- UN—University of Nebraska, Lincoln, Nebraska.
 USNM—United States National Museum, Washington, D. C.
 USPH—United States Public Health Service, Hamilton, Mont.
 WJ—Mr. W. W. Jones, Douglas, Arizona.
 WS—Dr. W. C. Stehr, Athens, Ohio.
 WSC—Washington State College, Pullman, Wash.

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MORPHOLOGY

Fernald (1927) has given a good account of the general structure of these wasps. In the present discussion it is necessary to consider several points not touched upon by Fernald. Among other morphological characters, the male genitalia usually possess characters which are of much taxonomic value. Not only do these characters assist in the separation of many of the species, but they also show relationships among the species. Detailed drawings of these genitalia have been prepared in place of involved descriptions. The most useful characters are found in the penis valvae, the sagittae, and the volsellae.

The metanotal flange, first mentioned by the writer (1938) in a paper on *Sphex*, is of much importance in separating the species. It is a thin, almost membranous process with a texture almost identical with that of the tegula. It begins below and extends behind the hind wing on the metanotum. It is entirely absent in some species. When present, it may be small, moderate, or large in size,

and may or may not be emarginate. The species in this genus which possess this flange seem to possess a clear phylogenetic relationship to each other. The species which do not possess it seem to be divided into at least two and probably more groups, on the basis of genitalia and other characters.

Immediately in front of the anterior ocellus, the frons usually forms a slight depression which is more or less attenuated anteriorly. The size and shape of this depression is of some importance in the separation of the species.

The female genitalia are so uniform in their structure that they appear to be of no taxonomic value. It is sometimes necessary to use a combination of characters in order to definitely determine a female specimen. Several characters in the females of *luctuosa* and *communis* illustrate why this is true. In *luctuosa* the arolium is usually extremely small, while in *communis* it is small but usually distinctly larger than in *luctuosa*. The average size of the arolium in *luctuosa* is definitely smaller than the average size in *communis*, but some specimens of both species are found in which the arolium is intermediate in condition between the two species. The punctation of the mesopleuron presents a similar situation. In *communis* the punctures on this plate are quite large and round, while in *luctuosa* they are generally smaller, elongated posteriorly, and there are frequently fine, forward-slanting striae between these punctures. But some specimens of either species may be found in which the punctation of the mesopleuron is intermediate in condition between the two species. The characters which have been found to be of value in the separation of the female *luctuosa* from the female *communis* are: the punctation of the clypeus, the frons near the frontal suture, and the mesopleuron, the shape of the clypeus, the strength of the suture marking the upper edge of the clypeus, the strength and depth of the frontal suture, the size of the arolium, the shape of Cell R_4 (third submarginal), and a few others. All of these characters occasionally exhibit intermediate conditions between *communis* and *luctuosa*, but each character varies entirely independently of the other characters. In a given specimen the arolium may show an intermediate condition between *luctuosa* and *communis*, but the punctation of the mesopleuron may show very clearly which species is concerned. Occasionally both these characters exhibit an intermediate condition in the same specimen. It is then necessary to use some of the other characters mentioned. It is theoretically possible for all of these characters to show an intermediate condition in the same specimen, but the

chances for this to occur are too slight to cause much concern. The writer has been able to determine without hesitation every one of the females of these two species, 1521 females of *communis* and *luctuosa* having been examined.

BIOLOGY

The biology of these solitary wasps has been studied rather carefully by several writers, and numerous persons have recorded interesting observations on their habits. It is unfortunate that specimens observed in the field are not more often caught and definitely labelled with a record of the observation. The habits of some of the species are unquestionably different from the habits of others, but it is almost impossible to point to any of the records of the habits or biology of these wasps and say what species is concerned. Nevertheless, all of the biological observations which are recorded in the literature are of much value in giving us an insight into the private lives of these solitary wasps. Species of *Podalonia* are somewhat timid or wary, but if caution is observed, the females may be approached closely and so can be easily observed. To be impatient or in a hurry will mean that results will be difficult or impossible to obtain.

The most complete observations have been made on *luctuosa*, Newcomer (1930) and Hicks (1931b, 1932) having published rather lengthy accounts of this species. The following discussion is based on their observations, and must be taken to represent the habits of *communis* as well as *luctuosa*, since both species were under observation but were not distinguished. The wasp comes forth and starts nesting as soon as the sun has sufficiently warmed the earth in the spring. This is before few other insects have emerged. The search for and capture of the prey, which consists of cutworms, is usually the first task of the wasp in nesting. Among the determined species of cutworms taken by this wasp are *Lycophotia saucia* Hubn., *Lycophotia margaritosa* Haw., *Chorizagrotis agrestis* Grt., *Euxoa testula* Sm. These cutworms, being nocturnal feeders, hide by day, concealed beneath the soil or some suitable object, and it is a task for the wasp to find them. The wasp hunts rapidly, almost feverishly, running from one grass clump to another, and inspecting the ground carefully. When searching for a larva, she follows a different method than she does when searching for a place to dig a nest. In the former case, she does not dig at any one spot to any great depth, but seems to carefully scour the ground but little below the surface. Also, she often snoops around stones, pulls away dead stems of plants, and looks beneath rubbish, all of

which she does not do while looking for a place to dig a nest. When a wasp finds a spot where she seems to suspect prey, she often works very excitedly for a time, even though she may not unearth a cutworm at that particular site. Again, she may begin digging in a given place but not stay long enough to secure her cutworm even though one is present.

The typical female continues her nesting as follows. After she finds a larva and brings it to the surface, she usually takes a few minutes to brush herself off. She then returns to the larva, grasps it just back of the head, and twists her abdomen towards its head on the ventral side. There she stings it between its first pair of true legs. She then advances progressively backward, moving the tip of her abdomen along the ventral side and appearing to feel with its tip before inserting the sting. The wasp may sting the larva many times, each time in a different segment of the ventral side. When she has finished, the larva is limp and motionless. Then the wasp begins a period of malaxation. Held ventral side up, her jaws open and close in the region back of the larva's head, while her short tongue laps the liquid issuing from its mouth.

After the period of malaxation, the female grasps the caterpillar firmly by the neck, ventral side up, and, straddling it, proceeds to run with it. The wasp usually carries her worm up into a clump of grass or weeds and hangs it over the axil of a leaf, or sometimes she hangs it in the crotch at the base of a low twig. After hanging up the worm, she looks for a place to dig her nest, and though the place selected is usually close by, it may be as far as twenty feet from the worm. The wasp uses her mandibles and forelegs to dig with, kicking the dirt out behind with her middle and hind legs. As the digging proceeds, she brings up load after load of soil particles held tightly between her mandibles and fore legs. These are dropped at the entrance, and are often kicked some distance as the wasp starts back into the hole. While the digging is going on in the nest the wasp's wings buzz loudly, but they are quiet when she is outside. The construction of the nest, which is about two inches deep and somewhat enlarged at the bottom, requires from ten minutes to half an hour. The work is usually continuous, though sometimes the wasp will flatten herself out at the entrance of the hole for a brief rest.

When the nest has been completed, the wasp returns to her cutworm, and she may have to search for a long time before finding it. When she arrives at her nest with the cutworm, she drops it with its head at the mouth of the nest, enters the hole, turns around,

comes up, and drags the cutworm down after her. When the worm is at the bottom of the nest, she deposits an egg on it. The process of filling the hole usually requires only about five minutes, but sometimes takes longer, and frequently sticks and stones of various sizes are seized and placed in it. The wasp may then place her head against the stones and press them against the dirt, while her feet are braced and her wings buzzing. She does not, however, hold the stone in her mandibles as some *Sphex* do. These stones are always left in the hole. When the hole has been filled, there follows a rather indiscriminate scratching of dirt on the surface. Newcomer saw one female continue this apparently aimless scratching for nearly half an hour, her accuracy gradually becoming more vague until finally she got entirely away from the location of the hole. After having completed the nest, a wasp may immediately begin a search for another cutworm or she may fly off and feed at mustard blossoms or other flowers. There is apparently never more than one larva and one egg to a given nest, although the wasp is an industrious worker and provisions many cells. Hicks states that one female wasp dug and provisioned seven burrows over a period of time.

Newcomer observed one wasp which demonstrated that its instincts were not iron bound. While digging her nest, a wasp was interrupted by Newcomer, who placed an active cutworm near the hole. She would not use this worm, and became so confused that she could not find the worm she had previously caught. Finally she started in search of another worm, and on finding it in a clump of grass, returned to her nest and cleaned it out, and then buried the worm in it. Thus she was capable of reversing the process, and going in search of another worm with which to provision the nest she had already constructed.

To the writer this last observation seems to indicate how the habits of *Sphex* may have originated. In *Sphex* the nest is constructed first and then a search is made for the worm. It would certainly seem that the method which *Sphex* uses is more recent and highly evolved than the method which *Podalonia* uses. There are other evidences which indicate that *Sphex* has evolved from *Podalonia* or from the stock of *Podalonia*. *Sphex* exhibits more intelligence in picking up stones and using them as tools in pounding down the earth. *Podalonia* does not hold the stones, but may press against them with her head.

The egg is attached to one of the anterior or medial segments of the worm. In twenty cases which Newcomer recorded, one egg

was placed on the third segment, one on the fourth, three on the fifth, ten on the sixth, and five on the seventh. Under artificial conditions at room temperature the egg hatches in eight or ten days. The larva's head is at the end of the egg attached to the worm, and, when fully developed, the larva merely makes a hole in the shell and starts to feed.

Larval growth requires about nine days under artificial conditions. The larva then spins a cocoon of brown silk, the construction of which requires a couple of days. Newcomer apparently believed that these wasps overwintered in these cocoons, as he had not noticed any adults after May. However, collecting data for several thousand specimens studied during the course of the present research show that *luctuosa* and *communis* are taken in abundance throughout the summer. During the summer, however, they are feeding and mating, but seldom if ever are they nesting, so they would therefore be found about flowers and seldom about their nesting grounds. Collecting data bring to light another very significant fact. The females of *luctuosa* and *communis* always occur later in the fall than the males, and they always occur much earlier in the spring than the males. This indicates the following life cycle: the females are fertilized during the summer and fall; the males die in late summer or early fall, while the females seek places in which to hibernate over the winter; in the spring the females emerge from hibernation and begin nest-building; the wasps which emerge from these nests consist of both males and females, and thus both sexes are found throughout the summer.

The Peckhams made careful studies of the habits and life histories of a great many different genera of social and solitary wasps. Their observations, however, were limited almost entirely to the region about Milwaukee, Wisconsin. In the introduction of their book "Instincts and Habits of the Solitary Wasps," they give a brief generalized life history of solitary wasps. They infer that these wasps overwinter in the cocoon, and make the following statement: "Probably no solitary wasp lives through the winter, those that come out in the spring or summer perishing in the autumn."

Hicks (1931a) made some very significant observations on the overwintering of *luctuosa* females. He has observed this wasp begin her capture of subterranean larvae very early in the spring or late winter (she may nest as early as December in southern California). This wasp is active very early in the season when few other insects are abroad. Near Owens Lake, at Boulder, Colorado, on September 15, Hicks made the following observation. A wasp was seen to make

her way to an open tunnel at the edge of a mound of sand. Reaching the entrance, she went in. Hicks then dug the mound away, exposing the tunnel. This tunnel was found to be almost vertical in position, with a nearly even diameter of 9 millimeters, and a total length of 17 centimeters. At the bottom was the wasp under observation and three more females resting together. During the active nesting season *Podalonia* females are distinctly solitary and very pugnacious whenever they have a chance meeting. This tunnel, in contrast to those constructed for prey which seldom measure more than three inches in length and usually less, was more than seven inches in length and more vertical in position. It appeared that it had been especially constructed or appropriated for winter quarters.

On September 26, Hicks watched another female enter a long tunnel. This one was nearly ten inches deep. That these females were not decrepit nor near the end of their days was evidenced by the fact that they lived for many weeks in cages in a greenhouse under conditions of high temperature and humidity.

Near Burbank, California, females were observed by Hicks during the winter, previous to Christmas. On December 28, a female was found already with captured prey. The weather was chilly, but she provisioned her nest. She was less active at this cool temperature and rested more often than usual. She soon made her way, in an erratic manner, to the edge of a plowed area some fifteen feet away, and suddenly disappeared into a tunnel. The tunnel was nearly 10 centimeters long. This place of refuge was the more interesting because of the fact that the soil in which it had been dug had been plowed not later than a month before. Since few wasps other than this species were about at this time, it seemed highly probable that she had constructed it.

Collecting data accumulated during the present research reveal that males have been collected extremely rarely in April, only occasionally in May, but abundantly in June, July, and August. They are present but scarce in September, and a straggler has been picked up in October. Females have been collected or observed every month of the year in California, and as early as the middle of March in Colorado. They become very abundant in April and May. Over the entire country the females are generally collected a month and a half to two months before any males are taken. This is about the length of time necessary for development of the wasp from egg to adult.

These collecting data added to Hicks' observations provide rather conclusive proof that *luctuosa* and *communis* overwinter in the adult stage. However, they do not prove that these two species

may not overwinter also as pupae or prepupae in their nests. The principal evidence at present that these two species do overwinter exclusively in the adult stage is found in the observation by Newcomer, namely, that there appears to be but one generation a year, as these wasps were never seen nesting after May.

At least some of the species of *Podalonia* differ in their biology from *luctuosa* and *communis* in that they nest at a different time of the year, and select different ecological areas for nesting. Balduf (1936) reported an observation made on August 26 at Lake Winnibigoshish, Minnesota, on *Podalonia violaceipennis* (examination of this material shows that *robusta* is also concerned). The wasps were seen dragging mature larvae of the notodontid moth, *Symmerista albifrons* S. & A. over the broad sandy beach. The caterpillars were buried near the water under the low growth of willow and poplar. The caterpillars had developed on the oaks bordering the lake, and the wasps dragged them for as much as 275 feet to get them to suitable nesting places.

Krombein (1936) made observations on *P. violaceipennis* about June 23 at Buffalo, New York. This species was noted nesting in only one situation: in little pockets of soil formed between two roots of several uprooted stumps.

On August 11, at Universal City, California, Hicks (1933) obtained a nest of a species of *Podalonia*, then considered to be *violaceipennis* but now believed to have been *sericea*.

Norman Appleton, parasitologist in charge of the Tent-caterpillar Laboratory at Santa Fe, New Mexico, sent several specimens of *occidentalis* to the writer and reported that this species was working with much effectiveness on the tent-caterpillar. He said that this species was active in June.

Thus some of these other species of *Podalonia* nest in mid or late summer. Collecting data of the commoner species show that the females and males both make their appearance at about the same time in the late spring or summer. It therefore seems almost certain that these species overwinter as pupae or prepupae.

Wasps of the genus *Podalonia* are affected either directly or indirectly by several parasites or predators. In the act of nest provisioning, the wasp hangs the caterpillar on a small twig or branch, or over the axil of a leaf, while she digs her nest. This habit seems to be a method of protecting the caterpillar from ants or other scavengers. Newcomer (1930) observed ants actually taking the caterpillar from the wasp while the wasp was trying to take the caterpillar to her nest.

These wasps appear to be unable to recognize a caterpillar which

has been parasitized, and so may store their nests with one of these parasitized worms. Hicks (1932) dug up one wasp nest and kept the caterpillar in the laboratory. Seventeen larvae of the ichneumonid parasite, *Meteorus vulgaris*, emerged from the caterpillar and pupated, and the adults subsequently emerged. The *Podalonia* egg hatched and the larva developed to maturity, and a normal female was produced except that she was smaller than the average. In another case eight larvae of the fly *Wagneria carbonaria* Panz. emerged, and in this case as before the wasp developed to an undersized adult.

Hicks (1933) also discovered a parasite which destroys the wasp larva completely. A species of *Podalonia*, then considered to be *violaceipennis*, takes as prey *Zale lunata* (Drury) and *Homoptera salicis* Behr. But sometimes a species of *Paniscus*, possibly *semi-rufus* Hgn., has already placed an egg on the caterpillar. In one case both parasites began development on the same host larva, *Paniscus* between the fore legs and *Podalonia* on an abdominal segment. Each fed in its respective position until about half grown, when the food gave out. The *Paniscus* larva attacked the *Podalonia* larva and devoured it. It was then able to complete its development to an adult. Observations indicated that in all cases the wasp larva was completely destroyed and devoured by the ichneumonid.

While the female *Podalonia* is preparing its nest, flies of the Sarcophagid tribe *Miltogrammini* have been frequently observed. Newcomer (1930) records the following observations. The commonest of these inquilines is *Hilarella hilarella* (Zett.). Often it is seen closely following a wasp that is carrying a cutworm, making short flights and alighting on convenient weeds to watch the progress of the wasp. Frequently when a wasp is constructing her nest, one or more of these flies may be seen on a grass blade or a stone, always facing the wasp. This fly deposits living young in the wasp's nest. It is always done after the wasp has dragged her prey into the hole, or while she is pulling it down the hole and before she has come out again. The fly alights at the mouth of the hole at the proper moment, almost instantaneously drops a few maggots into it, and immediately flies off. The fly larvae are sticky and adhere readily to the cutworm. They usually destroy the wasp egg in a very few minutes. In several cases, however, both maggots and wasp larvae were found feeding on the cutworm. However, the wasp larva invariably dies before it is very old. From two to seven maggots have been found in a single nest.

Another fly, *Taxigramma heteroneura* (Meig.), has similar hab-

its. A third species is *Metopia leucocephala* (Rossi). This species has been found attacking other species of Hymenoptera. It is not as common as the other two. This fly sits on a grass blade or a convenient stone and watches the construction of the nest. When the wasp has finished this and has gone for the cutworm, the fly crawls down the hole, deposits its young at the bottom and comes out before the wasp returns.

The wasp never seems to be aware of the existence of any of these inquilines. The flies usually keep at a certain distance and are not active while the wasp is watching.

CLASSIFICATION

Genus *Podalonia* Spinola

Fernald in 1927 gave a careful review of the history of the genus *Podalonia*. In view of the present findings, it seems desirable to consider the validity of *Podalonia* as a genus distinct from *Sphex*. There is no doubt but that the two groups are very closely related, but the present work shows that they can be separated by characters which the writer believes to be of true phylogenetic significance. The genitalia of *Sphex* and *Podalonia* are quite similar but for one invariable exception: the sagittae are distinctly different in shape in the two genera. A glance at any of the drawings of the genitalia of these two genera will demonstrate this fact. As a character to be used in both sexes, the shape of the first abdominal tergite is the best character which can be used. In *Podalonia* the petiole is composed of part of the first abdominal sternite, and the first abdominal tergite is considerably expanded posteriorly. This tergite is generally more expanded in the females than in the males, but in both sexes the condition is distinct from that in *Sphex*. In *Sphex* the petiole is composed of the entire first abdominal segment including both dorsal and ventral parts, the first tergite being only slightly expanded posteriorly. The spiracle of this first tergite is found at about the middle of the plate in *Podalonia*, and about two-thirds of the way back in *Sphex*. Several other characters have been found to be useful but they are not very reliable. The characters mentioned have been found to be reliable in every species of *Sphex* and *Podalonia* which the writer has seen, and it is almost certain that they will be found to be reliable over the entire world.

KEY TO SPECIES

In species with an * it is necessary to examine the genitalia (in doubtful specimens).

1. Males. Inner margin of eyes converging below; antennae 13-segmented; 7 visible abdominal segments	2
Females. Inner margin of eyes parallel or nearly so; antennae 12-segmented; 6 visible abdominal segments	25
2. Abdomen entirely black or blue-black	3
Abdomen entirely red, red and black, or red and blue	10
3. Abdomen distinctly black	4
Abdomen distinctly blue or blue-black	6
4. With a metanotal flange	<i>melaena</i>
Without a metanotal flange	5
5. Clypeus slightly reflexed, scarcely bending down to lateral margin; pilosity of thorax entirely black.	
	<i>sonorensis differentia</i>
Clypeus not at all reflexed, almost flat across the central part but bending down to lateral margin; pilosity of thorax partly white	<i>communis intermedia</i>
6. Head and thorax entirely blue	<i>caerulea</i>
Head and thorax entirely or almost entirely black	7
7. Without a metanotal flange	<i>sonorensis differentia</i>
With a metanotal flange	8
8. Pleura very coarsely punctate, metapleuron and propodeal side appearing very coarsely reticulate; frontal suture usually appearing extremely wide; frons granulate, with a great many large deep punctures	<i>*argentifrons</i>
Pleura moderately punctate, metapleuron and propodeal side more or less prominently ridged; frontal suture usually distinct but not extremely wide; large punctures of frons sparse to moderate in number	9
9. Mesopleuron with a moderate number of large and a great many tiny punctures, short white sericeous hairs arising from the tiny punctures; surface of mesopleuron between punctures scarcely or not at all creased, but distinctly reticulate; extreme southwestern United States	<i>*parallela</i>
Mesopleuron with a moderate number of large but only a few tiny punctures, rarely with short sericeous hairs arising from the tiny punctures; surface of mesopleuron creased into more or less prominent ridges; distributed throughout most of the western half of North America	<i>*mexicana</i>
10. A spur at apex of fore coxa within	11
No spur at apex of fore coxa within	12
11. Legs at least partly bright red; without a metanotal flange.	
	<i>morrisoni</i>
Legs entirely black; with a metanotal flange	<i>valida</i>

12. Without a metanotal flange 13
 With a metanotal flange (in some individuals this may be im-
 perfectly developed, and a careful examination is neces-
 sary) 16
13. Clypeus more or less broadly transverse (fig. 48); abdomen red
 and black **luctuosa*
 Clypeus narrowly transverse (figs. 45, 46, 47) 14
14. Clypeus slightly reflexed, scarcely bending down to lateral
 margin; pilosity of thorax usually entirely black; abdomen
 usually red and dark blue **sonorensis*
 Clypeus not at all reflexed, almost flat across central part but
 bending down to lateral margin; pilosity of thorax at least
 partly white; abdomen red and black 15
15. Pilosity of clypeus entirely black; distributed throughout most
 of western half of North America *communis*
 Pilosity of clypeus partly white; Mexico and Central America.
communis alpestris
16. Propodeum with a dense pubescent patch on each side of petiole
 attachment; metapleuron glossy, with many large deep
 punctures; moderately large species *pubescens*
 Propodeum with a rather thin pubescent patch on each side of
 petiole attachment, or with none at all 17
17. Propodeum with a rather thin pubescent patch on each side of
 petiole attachment; clypeus broadly transverse as in fig.
 43; very large species *montana*
 Propodeum without a pubescent patch; moderate-sized spe-
 cies 18
18. Head and pleura very coarsely punctate, metapleuron and pro-
 podeal side appearing very coarsely reticulate; abdomen
 red and blue; clypeus as in fig. 36 **puncta*
 Head and pleura moderately punctate, metapleuron and pro-
 podeal side more or less ridged 19
19. Metapleuron with many large deep punctures, approximately
 anterior half highly glossy; metanotal flange quite large;
 thoracic pilosity entirely black; clypeus as in figure 27.
**clypeata*
 No such combination of characters 20
20. Metanotal flange very large, usually with a strong emargi-
 nation **violaceipennis*
 Metanotal flange moderate or small, or if large without a
 prominent emargination 21
21. Metanotal flange small; thoracic pilosity mostly white; cell
 R4 (3rd submarginal) almost always twice as wide at bot-

- tom as at top; clypeus usually broadly transverse; abdomen red and black**occidentalis*
- No such combination of characters 22
22. Mesopleuron glossy, with abundant white sericeous hairs; frontal depression deep and well-marked; metapleuron rather crinkly; pilosity of thorax mostly white; metanotal flange usually large**sericea*
- Mesopleuron distinctly reticulate, with no sericeous hairs, or with a few very short hairs; frontal depression moderate or small 23
23. Pilosity of thorax usually partly white except in eastern United States; abdomen usually red and dark blue; metapleuron more or less distinctly ridged**robusta*
- Thoracic pilosity almost without exception entirely black; abdomen red and black 24
24. Metanotal flange usually moderately large; petiole about equal in length to hind coxa and trochanter together*mickeli*
- Metanotal flange always small; petiole distinctly shorter than hind coxa and trochanter together; Western Coast only.
- compacta*
25. Abdomen entirely black or blue-black 26
- Abdomen entirely red, red and black, or red and blue 34
26. Clypeal margin with two small teeth (fig. 35); abdomen dark blue *sonorensis* *differentia*
- Clypeal margin without teeth 27
27. Abdomen distinctly black 28
- Abdomen distinctly blue or blue-black 31
28. With a metanotal flange; metapleuron with large distinct punctures, flat-topped ridges, and a glossy surface *melaena*
- Without a metanotal flange 29
29. Frontal suture rather deep to anterior ocellus; frontal depression granulate, rather dull; punctures of mesopleuron usually moderate in size, shallow and elongated posteriorly; arolium very small, barely projecting beyond base of claws (fig. 28) *luctuosa*
- Frontal suture obsolescent in frontal depression; frontal depression with smooth reticulation, frequently glossy; punctures of mesopleuron usually large, round; arolium distinctly projecting between claws 30
30. Arolium medium to small in size (fig. 29); clypeus broadly, but not very strongly, bulging; North America and Mexico.
- communis*

- Arolium large (fig. 30); clypeus rather strongly bulging in center; Central America *communis alpestris*
31. Clypeus highly glossy, moderately bulging, with a great many rather uniformly-sized large round punctures; frontal depression smoothly reticulate, crescent-shaped, well-defined by large punctures which are very abundant over all of frons except in the depression *puncta*
- Clypeus with a moderate number of variable-sized punctures; frontal depression attenuated anteriorly, not well-defined by large punctures 32
32. Pleura very coarsely punctate, metapleuron and propodeal side appearing very coarsely reticulate; frontal suture usually appearing extremely wide; frons granulate, with a great many large deep punctures *argentifrons*
- Pleura moderately punctate, metapleuron and propodeal side more or less prominently ridged; frontal suture usually distinct but not extremely wide; large punctures of frons sparse to moderate in number 33
33. Mesopleuron with surface creased into more or less prominent ridges; clypeus slightly to moderately bulging and with smooth reticulation; distributed throughout most of western half of North America *mericana*
- Mesopleuron with surface between punctures scarcely or not at all creased, but distinctly reticulate; clypeus usually moderately bulging and distinctly reticulate; extreme southwestern United States *parallela*
34. Clypeal margin with teeth 35
- Clypeal margin without teeth 39
35. A spur at apex of fore coxa within 36
- No spur at apex of fore coxa within 37
36. Legs at least partly bright red; clypeal margin with two small teeth; without a metanotal flange *morrisoni*
- Legs black; clypeal margin with several strong teeth; with a metanotal flange *valida*
37. Without a metanotal flange; abdomen red and dark blue; clypeal margin with two small teeth (fig. 39) *sonorensis*
- With a metanotal flange; abdomen red and black or entirely red; clypeal margin with broad, strong teeth 38
38. Metanotal flange very large, slightly emarginate; metapleuron with a very glossy surface between the punctures; length 15-18 mm. *clypeata*

- Metanotal flange moderately large; metapleuron with many large punctures, little surface between these punctures; length 20 mm. *montana*
39. Propodeum with prominent pubescent patch on each side of petiole attachment *pubescens*
 Propodeum without prominent pubescent patch on each side of petiole attachment 40
40. Metanotal flange very large and with a strong emargination; clypeus bulging only slightly in center, with many large and tiny punctures, distinctly reticulate, giving a dull appearance; metapleuron with almost no regular ridges, anterior part reticulate or granulate, occasionally glossy. *violaceipennis*
 Metanotal flange moderate or small, or if large without a strong emargination 41
41. Clypeus bulging only very slightly in center, with many large punctures, surface reticulate; abdomen red and black; cell R4 (3rd submarginal) almost always twice as wide at bottom as at top; metanotal flange small *occidentalis*
 No such combination of characters 42
42. Clypeus strongly bulging, reticulate, with many large punctures; mesopleuron with a great many tiny punctures and a smooth, highly glossy surface; frontal depression deep and fairly well marked; metanotal flange usually large; abdomen usually red and dark blue, rarely red and black, rarely entirely red *sericea*
 No such combination of characters 43
43. Petiole slender, distinctly longer than hind coxa; clypeus moderately to rather strongly bulging, peak of bulge below middle of clypeus dorso-ventrally; clypeus reticulate throughout; abdomen red and dark blue, rarely red and black. *robusta*
 Petiole rather stout, very slightly longer than hind coxa or even shorter; clypeus glossy between peak of bulge and margin; abdomen red and black 44
44. Metanotal flange usually moderately large; petiole about equal in length to hind coxa or slightly longer; clypeus strongly bulging *mickeli*
 Metanotal flange always small; petiole distinctly shorter than hind coxa; clypeus moderately bulging; Western Coast only *compacta*

SYSTEMATIC TREATISE OF THE SPECIES

1. *Podalonia morrisoni* (Cameron)

(Figures 5, 34, 39, 57)

1888. *Ammophila morrisoni* Cameron, Biol. Centr.-Amer., Hym. 2: 21. Male.
1903. *Ammophila morrisoni* Melander, Psyche 10: 156-164. Male.
1924. *Psammophila nicholi* Carter, Ent. News 35: 366. Female.
1927. *Podalonia nicholi* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 17-20. Female, male.
1927. *Podalonia morrisoni* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, p. 38. Male.

Male.—(See figure 5 for genitalia.) Length 17 mm. Head: clypeal margin broadly truncate, central part arcing upwards slightly; clypeus somewhat reflexed; entire front of head between eyes unusually narrow for genus; frontal suture distinct and broad up to the moderately deep frontal depression, but obsolete in this depression; frontal depression very minutely reticulate, with many tiny but no large punctures, rest of frons with many moderate-sized and tiny punctures; pilosity of head white. Thorax: collar rather narrowly rounded; mesopleuron with many moderate-sized punctures, most of these with a small crescent-shaped ridge in front of them, and with very many tiny punctures; metapleuron and propodeal side with the punctures confused, in no definite arrangement, surface more or less scratchy; propodeal disk with sharply defined ridges, those of anterior part slanting posteriorly from median line, those of posterior part running almost transversely; no metanotal flange; pilosity of thorax white, quite dense. Legs; fore coxa with spur on inner side; coxae and trochanters black, anterior portion of front and middle femora red, posterior portion black, hind femora entirely black except for red tip; front and middle tibiae entirely red, hind tibiae red anteriorly and black posteriorly; tarsi black. Petiole: black, with white pilosity anteriorly. Abdomen: first segment red with several dorsal black spots, second and third segments red, fourth red ventrally and black dorsally, rest of abdomen black.

Female.—Length 18 mm. Head: clypeus very broadly but not strongly bulging; clypeal margin with two teeth, each tooth about as close to middle of clypeal margin as to nearest eye; eyes slightly converging below; frons with a moderate number of

large punctures, a very large number of tiny punctures, the tiny punctures almost giving a reticulated appearance to the surface; frontal suture evident to anterior ocellus, but tending to become obsolescent in frontal depression; pilosity of head white. Thorax: a weak silvery pubescent patch beside petiole attachment; pilosity of thorax white, not as heavy as in male. Legs: all coxae, a line on posterior side of fore and middle and all of hind trochanters, black, otherwise legs red. Abdomen: entirely red.

Redescribed from a male collected in Imperial Co., California, May 1911 (J. C. Bridwell); female redescribed from the holotype of *P. nicholi* (Carter), collected in Tucson, Arizona, April 5, 1924 (A. A. Nichol); both are located in the collection of the University of Minnesota, St. Paul, Minn.

Holotype.—Male, Northern Sonora, Mexico (Morrison). According to H. T. Fernald, and confirmed by R. B. Benson, the type specimen cannot be located in the British Museum, and a specimen labelled "*Ammophila morrisoni* Cam. Type" is a female *sonorensis*. The figure of the genitalia (see note on Cameron's drawings under the section "Methods and Materials") and the original description are available for comparisons.

Allotype.—Female, Tucson, Arizona, April 5, 1924 (A. A. Nichol). The holotype of *nicholi* Carter becomes the allotype of *morrisoni*.

Fernald (1927) designated an allotype male of *nicholi*. This specimen was collected in Southern California, and is deposited in the collection of the American Entomological Society, Philadelphia, Pa.

Specimens examined: 1 ♂, 6 ♀; total specimens 7.

CALIFORNIA: Imperial Co., 4 ♀, May 1911 (J. C. Bridwell) [USNM, UM]; Los Angeles Co., ♀ [USNM].

Variations.—Female: margin of clypeus may become worn and cause teeth to show less distinctly; larger punctures of mesopleuron may be practically absent; mesopleuron may have short, moderately strong ridges; posterior trochanters may be partly red.

The series of specimens examined indicates that only one species is involved, and that *nicholi* must become a synonym of *morrisoni*. This is substantiated by the original descriptions of *morrisoni* and *nicholi* and the genitalia drawing by Cameron as compared with specimens at hand.

2. *Podalonia luctuosa* (Smith)

(Figures 1, 28, 48, 63)

1856. *Ammophila luctuosa* Smith, Cat. Hym. Brit. Mus. 4: 224. Female.
- ?1865. *Ammophila communis* Cresson, Proc. Phila. Ent. Soc. 4: 462. Male (in part).
1865. *Ammophila luctuosa* Cresson, Proc. Phila. Ent. Soc. 4: 462. Female (in part).
- ?1867. *Ammophila luctuosa* Saussure, Reise d. Novara, Zool. 2, pt. 1, Hym., p. 25. Female.
1882. *Ammophila luctuosa* Provancher, Natural. Canad. 13: 13. Female.
1882. *Ammophila communis* Provancher, Natural. Canad. 13: 13. Male (in part).
1883. *Ammophila luctuosa* Provancher, Faun. entom. Canad. Hym. 2: 614. Female.
1883. *Ammophila communis* Provancher, Faun. entom. Canad. Hym. 2: 614. Male (in part).
- ?1888. *Ammophila luctuosa* Cameron, Biol. Centr.-Amer., Hym. 2: 23. Female.
1902. *Psammophila luctuosa* Melander & Brues, Biol. Bul. 3: 40-42. Female (in part).
1902. *Psammophila communis* Melander & Brues, Biol. Bul. 3: 40-42. Male (in part).
1902. *Psammophila pacifica* Melander & Brues, Biol. Bul. 3: 40-42. Male.
1903. *Ammophila luctuosa* Melander, Psyche 10: 156-164. Female (in part).
1903. *Ammophila pacifica* Melander, Psyche 10: 156-164. Male.
1903. *Ammophila violaceipennis* Melander, Psyche 10: 156-164. Male (in part).
1908. *Psammophila luctuosa* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Female (in part).
1917. *Psammophila violaceipennis* Mickel, Univ. Nebr. Studies 17: 87-88. Male (in part).
1917. *Psammophila luctuosa* Mickel, Univ. Nebr. Studies 17: 87-88. Female (in part).
1917. *Psammophila violaceipennis* Rohwer, Proc. U. S. Nat. Mus. 53: 241. Male only.
- ?1917. *Psammophila luctuosa* Rohwer, Proc. U. S. Nat. Mus. 53: 241. Female (in part).

1917. *Psammophila luctuosa* Rohwer, Conn. Geol. & Nat. Hist. Surv. 22: 681. Female.
1917. *Psammophila violaceipennis* Rohwer, Conn. Geol. & Nat. Hist. Surv. 22: 681. Male (in part).
1925. *Psammophila luctuosa* Carter, Canad. Ent. 57: 132. Female only (in part).
- ?1925. *Psammophila violaceipennis* Carter, Canad. Ent. 57: 132. Male (in part).
1927. *Podalonia luctuosa* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 21-26. Female only (in part).
1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30-37. Male only (in part).
1929. *Podalonia violaceipennis* Bequaert, Bul. Brook. Ent. Soc. 24: 220-221. Male, female (in part).
- ?1930. *Podalonia luctuosa* Newcomer, Ann. Ent. Soc. Amer. 31: 17-43. Female (in part).
1931. *Podalonia violaceipennis* form *luctuosa* Fernald, Canad. Ent. 63: 278-279. Female (in part).
- ?1931. *Podalonia luctuosa* Hicks, Pan-Pacific Ent. 8: 49-51. Female.
- ?1931. *Podalonia luctuosa* Hicks, Bul. Southern Calif. Acad. Sci. 30: 75-82. Female.
- ?1932. *Podalonia violaceipennis* form *luctuosa* Hicks, Psyche 39: 150-154. Female.

Male.—(See figure 1 for genitalia.) Length 17 mm. Head: clypeus broadly truncate, with no central emargination; frontal suture distinct to anterior ocellus; a broad and quite shallow frontal depression; surface of frontal depression finely reticulate and with very many small punctures, rest of frons with only a few small punctures but with numerous large punctures; pilosity of head black. Thorax: collar narrowly rounded; rectangle with rather shallow, moderate-sized punctures, mesopleuron with these punctures elongated; metapleuron with the moderate-sized punctures elongated and with fine ridges between them; propodeal side with many moderate-sized to small punctures, fine ridges as on metapleuron; tiny punctures scarcely evident anywhere on thorax, but the surface is roughened or reticulate; no metanotal flange; pilosity of thorax entirely white except on anterior part of prothorax, where it is black. Wings: vein R5 (2nd transverse cubital) nearly perpendicular to vein Rs (radial). Abdomen: first two, and anterior half of third, segments red, rest of abdomen black.

Female.—Length 16 mm. At first glance appearing quite different from male; structurally, however, practically identical except for usual sexual differences. Head: clypeus slightly to very moderately bulging in middle, sloping gradually to upper edge, which is curved and not very distinctly marked; surface of clypeus with many large punctures, very few small punctures, distinctly reticulate on upper half but rather glossy on lower part; frontal depression distinctly reticulate. Thorax: pilosity black. Legs: arolium very small, barely projecting beyond base of claws. Abdomen: entirely black.

Redescribed from a male and a female located in the collection of the University of Minnesota at St. Paul, Minn. Male, Parkdale, Colorado, June 15, 1926 (E. G. Anderson); female, Westcliff, Colorado, June 19, 1926 (E. G. Anderson).

Holotype.—Female, Rocky Mountains. It is located in the British Museum (Natural History) in London.

Allotype.—Male; the holotype of *pacifica* becomes the allotype of *luctuosa*. It was collected at Pacific Grove, California, July 9, 1897, by Miss Rose Patterson, and is now located in the Museum of Comparative Zoology at Cambridge, Mass.

Specimens examined: 722 ♂, 747 ♀; total specimens 1469.

Luctuosa has been collected in the following states and provinces: MAINE, NEW HAMPSHIRE, VERMONT, MASSACHUSETTS, CONNECTICUT, NEW YORK, MICHIGAN (May 21–Oct. 12), WISCONSIN, MINNESOTA (May 16–Sept. 15), NORTH DAKOTA, SOUTH DAKOTA, NEBRASKA, KANSAS, MONTANA (Apr. 26–Aug. 16), WYOMING, COLORADO (Mar. 20–Nov. 1), NEW MEXICO, UTAH (Mar. 11–Oct. 4), ARIZONA, IDAHO, NEVADA, WASHINGTON (Mar. 21–Sept. 9), OREGON, CALIFORNIA (Jan.–Dec.), NOVA SCOTIA, NEW BRUNSWICK, QUEBEC, ONTARIO, MANITOBA, SASKATCHEWAN, ALBERTA, BRITISH COLUMBIA, YUKON TERRITORY.

Variations.—Rarely with a very slight metanotal flange; rarely with frontal suture obsolescent or entirely obsolete; in eastern specimens rectangle usually with fine ridges running forwards and downwards, these not usually present in western specimens; in some western specimens punctures of rectangle may be rather large, deep and round, almost as in *communis*. Male: length 12–20 mm.; in eastern United States and Canada pilosity usually entirely black, in western United States and Canada pilosity usually white on most of thorax; all gradations between the two conditions found in Minnesota; clypeal margin occasionally not broadly truncate but more rounded, sometimes making an extra bend before extending transversely to center; frontal depression sometimes with only a few punctures;

rarely pilosity of cheeks white, though with a few hairs black basally, and tips of a few hairs on frons white, otherwise head black pilose. Female: length 12–20 mm.; clypeus rarely almost flat, with no bulge whatever; upper edge of clypeus occasionally not defined at all; arolium sometimes large enough to be confusing with *communis*; one female with dull red spots on dorsum of first, second, and third abdominal segments.

Luctuosa is extremely closely related to *communis*. The most reliable characters to use in separating these two species are given following the description of *communis*.

3. *Podalonia communis* (Cresson)

(Figures 2, 29, 47, 62)

1865. *Ammophila communis* Cresson, Proc. Phila. Ent. Soc. 4: 462. Male (in part).
 1865. *Ammophila luctuosa* Cresson, Proc. Phila. Ent. Soc. 4: 462. Female (in part).
 ?1867. *Ammophila luctuosa* Saussure, Reise D. Novara, Zool. 2, pt. 1, Hym., p. 25. Female.
 ?1888. *Ammophila luctuosa* Cameron, Biol. Centr.-Amer., Hym. 2: 23. Female.
 ?1888. *Ammophila piceiventris* Cameron, Biol. Centr.-Amer., Hym. 2: 22. Female.
 1888. *Ammophila piceiventris* var. Cameron, Biol. Centr.-Amer., Hym. 2: 22. Female.
 1902. *Psammophila luctuosa* Melander & Brues, Biol. Bul. 3: 40–42. Female (in part).
 1902. *Psammophila communis* Melander & Brues, Biol. Bul. 3: 40–42. Male (in part).
 ?1903. *Ammophila piceiventris* Melander, Psyche 10: 156–164. Female.
 1903. *Ammophila luctuosa* Melander, Psyche 10: 156–164. Female (in part).
 1903. *Ammophila violaceipennis* Melander, Psyche 10: 156–164. Male (in part).
 1908. *Psammophila luctuosa* H. S. Smith, Univ. Nebr. Studies 8: 330–331. Female (in part).
 1917. *Psammophila violaceipennis* Mickel, Univ. Nebr. Studies 17: 87–88. Male (in part).
 1917. *Psammophila luctuosa* Mickel, Univ. Nebr. Studies 17: 87–88. Female (in part).
 1917. *Psammophila luctuosa* Rohwer, Proc. U. S. Nat. Mus. 53: 241. Female.

1925. *Psammophila luctuosa* Carter, *Canad. Ent.* 57: 132.
Female only (in part).
- ?1925. *Psammophila violaceipennis* Carter, *Canad. Ent.* 57: 132.
Male (in part).
1927. *Podalonia luctuosa* Fernald, *Proc. U. S. Nat. Mus.* 71,
Art. 9, pp. 21-26. Female only (in part).
1927. *Podalonia violaceipennis* Fernald, *Proc. U. S. Nat. Mus.*
71, Art. 9, pp. 30-37. Male only (in part).
1929. *Podalonia violaceipennis* Bequaert, *Bul. Brook. Ent. Soc.*
24: 220-221. Male, female (in part).
1930. *Podalonia luctuosa* Newcomer, *Ann. Ent. Soc. Amer.* 31:
17-43. Female (in part).
- ?1931. *Podalonia luctuosa* Hicks, *Pan-Pacific Ent.* 8: 49-51.
Female.
- ?1931. *Podalonia luctuosa* Hicks, *Bul. Southern Calif. Acad. Sci.*
30: 75-82. Female.
1931. *Podalonia violaceipennis* form *luctuosa* Fernald, *Canad.*
Ent. 63: 278-279. Female (in part).
- ?1932. *Podalonia violaceipennis* form *luctuosa* Hicks, *Psyche* 39:
150-154. Female.

Male.—(See figure 2 for genitalia.) Length 15 mm. Head: clypeal margin narrowly transverse, transverse part about equal in length to each side part; clypeus almost flat across central part, but bending down to lateral margin; frontal suture weak, entirely obsolete in front of ocellus; frontal depression weak, smoothly reticulate and with many small punctures, rest of frons similar but also with many large punctures; pilosity of head black. Thorax: collar narrowly rounded; rectangle with many large round punctures, surface reticulate and without ridges; mesopleuron with many large round punctures, those lower down tending to elongate slightly; metapleuron with the moderate-sized punctures slightly elongated and with fine ridges between them; propodeal side with many moderate-sized punctures, fine ridges as on metapleuron; tiny punctures scarcely evident anywhere on thorax, but the surface is roughened or reticulate; no metanotal flange; pilosity of prothorax and mesonotum black, of rest of thorax white. Wings: vein R5 (2nd transverse cubital) slanting somewhat outwardly from junction with vein Rs (radial). Abdomen: first, second, and anterior half of third segments red, rest of abdomen black.

Female.—Length 15.5 mm. At first glance appearing quite different from male; structurally, however, practically

identical except for the usual sexual differences. Head: clypeus moderately bulging in middle, receding as much laterally as ventrally, receding more rapidly dorsally to form a distinctly marked upper edge; frontal depression smoothly reticulate, somewhat glossy. Thorax: pilosity black. Legs: arolium small, but showing entirely free between claws. Abdomen: entirely black.

Redescribed from a male and a female located in the collection of the University of Minnesota, St. Paul, Minn. Male, Pingree Park, Larimer Co., Colorado, Aug. 20, 1926 (R. W. Dawson); female, Westcliff, Colorado, June 9, 1926 (E. G. Anderson). The male was compared with the holotype.

Holotype.—Male, Colorado. It is in the collection of the American Entomological Society, Philadelphia, Pa.

Allotype.—The female described herein is designated as the allotype.

Piceiventris was described by Cameron, the description apparently being based on one female specimen. R. B. Benson found that this agrees with *communis* in structure, and believed it to be merely a variety of that species. The type was collected at Quetzaltenango, Guatemala. It is not possible to decide conclusively whether or not *piceiventris* should rank as a distinct species until additional specimens have been collected from this geographical region.

Specimens examined: 592 ♂, 774 ♀; total specimens 1366. *Communis* has been collected in the following states, provinces, and countries: NORTH DAKOTA, SOUTH DAKOTA, NEBRASKA, KANSAS, MONTANA, WYOMING, COLORADO (Mar. 19–Sept. 7), NEW MEXICO, UTAH (Apr. 8–Oct. 3), ARIZONA, IDAHO, NEVADA, WASHINGTON (Mar. 17–Oct. 15), OREGON, CALIFORNIA (Apr. 8–Nov. 1), ALBERTA, BRITISH COLUMBIA (Apr. 5–Nov. 10), MEXICO.

Variations.—Rarely with a very slight metanotal flange; occasionally frontal suture very distinct to anterior ocellus, sometimes suture entirely absent except for short distance between the antennal bases; pleura sometimes with very coarse irregular ridges. Male: length 12–18 mm.; abdomen occasionally all black except for red on apex of first and base of second segments; transverse part of clypeal margin sometimes curved upwards in middle. Female: length 11–18 mm.; lower margin of clypeus sometimes quite irregular; in one specimen first dorsal abdominal segment dark red.

Communis is very closely related to *luctuosa*. The males of these two species are best and most easily separated by the male

genitalia and by the shape of the clypeal margin, which is narrowly transverse in *communis* and broadly transverse in *luctuosa*. It is frequently necessary to use a combination of characters in order to separate the females. In *communis*: frontal suture obsolescent in frontal depression; frontal depression with smooth reticulation, frequently glossy; punctures of mesopleuron large and round; arolium small, but distinctly projecting between claws; vein R5 (2nd transverse cubital) slanting somewhat outwardly from the junction with vein Rs (radial); upper edge of clypeus distinctly and rather deeply marked. In *luctuosa*: frontal suture rather deep to anterior ocellus; frontal depression granulate, rather dull; punctures of mesopleuron moderate in size, elongated posteriorly and frequently with fine ridges between them; arolium very small, barely projecting beyond base of claws; vein R5 (2nd transverse cubital) nearly perpendicular to vein Rs (radial); upper edge of clypeus frequently not very distinctly marked.

4. *Podalonia communis* subspecies **intermedia** new subspecies
(Figure 62)

Male.—Length 14 mm. Head, thorax and abdomen black. Pilosity of head, prothorax, mesonotum and part of mesopleuron black, of most of mesopleuron and metapleuron white; propodeum with bluish-black and black pilose hairs, with a few white hairs; petiole with black pilosity.

Female. Unknown.

Holotype.—Male, Dist. Fedrl., Mexico (L. Conradt). It is deposited in the United States National Museum, Washington, D. C.

This subspecies is structurally identical with the typical *communis*. Its abdomen is entirely black instead of red and black, and the pilosity is black over a greater part of the thorax than in *communis*. The holotype is the only known specimen of this subspecies.

5. *Podalonia communis* subspecies *alpestris* (Cameron)
(Figures 30, 46, 62)

1856. *Ammophila atriceps* Smith, Cat. Hym. Brit. Mus. 4: 221. Male only.

1888. *Ammophila alpestris* Cameron, Biol. Centr.-Amer., Hym. 2: 21. Male.

1903. *Ammophila alpestris* Melander, Psyche 10: 156–164. Male.

1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30–37. Male (in part).

Male.—Length 14 mm. Clypeal margin narrowly transverse, the central part arcing upwards slightly; pilosity of head mixed black and white on clypeus, black on frons and vertex, white on cheeks.

Female.—Length 16 mm. Clypeus slightly more bulging in middle than in typical *communis*; arolium large, being considerably larger than in typical *communis* and almost as large as in *violaceipennis*.

The description of the male is from Cameron's paratype, this having been compared with the holotype by Dr. R. B. Benson; data for this specimen: Volcan de Chiriqui, 4000–6000 ft. (Champion). It is located in the British Museum (Natural History) in London. The description of the female is from a specimen located in the United States National Museum, Washington, D. C.; data for this specimen: La Carpentera, Costa Rica, April 1924 (H. W. Atkinson).

Holotype.—Male, Volcan de Chiriqui 4000–6000 ft. (Champion). It is located in the British Museum (Natural History), London.

Allotype.—The female described herein is designated as the allotype.

Ammophila atriceps was described by Smith in 1856 from a female and a male collected in Mexico. According to Fernald (1927), and confirmed by R. B. Benson (in lit.), the holotype cannot be located in the British Museum. Therefore the original description only is available for comparison. Since Smith described the female of *atriceps* first, the female must stand as the type of the species on the basis of priority. The description of the female indicates, however, that Smith did not have a specimen of *Podalonia* but instead a specimen of *Sphex*. Smith mentions that the thorax has long thin griseous pubescence, and in North America this occurs in the female of only one species of *Podalonia*, namely *P. morrisoni*. The description indicates that *morrisoni* could not be the species in question. Further, his description of *atriceps* is placed among the descriptions of other species of *Sphex*, and he does not mention the petiole as being short. He mentions that the petiole is short in all the species of New World *Podalonia* which he personally studied. The species *atriceps* must therefore be placed in the genus *Sphex*.

There is one male specimen, located in the British Museum, which may be considered as the male type of *atriceps*. This male, however, is a *Podalonia*. In the males of *Podalonia* the first abdominal tergite is not as conspicuously expanded as it is in the

females. Smith apparently confused this condition with the condition in *Sphex*. The female and male of *atriceps* were apparently collected at the same locality and Smith assumed them to belong to the same species. Dr. Benson studied the male type of *atriceps* and found it to be conspecific with *Podalonia alpestris*.

Specimens examined: 21 ♂, 4 ♀; total specimens 25.

COSTA RICA: La Carpentera, 19 ♂, April 1924 (W. M. Mann) [USNM, UM]; San Jose, ♂, 1928 (M. Valerio) [USNM]; Volcano Arazu, ♀, Feb. 23, 1902 (L. Bruner) [UN]; Volcano Arazu, 2 ♀, June 22, 1902 (M. Cary) [UN].

Variations.—Male: clypeal margin more variable than in *communis*, in some specimens margin exactly as in typical *communis*, in others more broadly truncate and frequently arcing upwards in center.

There may be some question as to whether *alpestris* should rank as a subspecies of *communis* or as a distinct species. There are not enough data at present to give a conclusive decision. Present data show that *alpestris* has a distribution range which is adjacent to that of *communis* but does not overlap it. Several structural characters show slight modifications, but the genitalia are identical with *communis*. The modifications exhibited by *alpestris* may be at least indirectly caused by the extension of *communis* far into the tropical region.

6. *Podalonia sonorensis* (Cameron)

(Figures 3, 35, 45, 53)

1888. *Ammophila sonorensis* Cameron, Biol. Centr.-Amer., Hym. 2: 21. Male, female.
 ?1903. *Ammophila sonorensis* Melander, Psyche 10: 156-164. Female.
 ?1903. *Ammophila violaceipennis* Melander, Psyche 10: 156-164. Male (in part).
 1927. *Podalonia sonorensis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 20-21. Female.
 1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30-37. Male (in part).

Male.—(See figure 3 for genitalia.) Length 10 mm. Head: clypeal margin extending downwards and somewhat inwards from eyes for a short distance, then slightly more inwards for about an equal distance, then transversely to center, transverse part about one-third length of entire margin; clypeus appearing slightly concave below middle from

nearly one side to the other, giving a reflexed appearance; frontal suture weak, a very thin line visible to anterior ocellus; frontal depression very slight, granulate; rest of frons reticulate, with large punctures, only a very few tiny punctures; pilosity of head black. Thorax: collar rather narrowly rounded; rectangle with many large punctures, some with short ridges between them; meso- and metapleura and propodeal side with many large punctures so close together as to give a very coarsely reticulated appearance; no metanotal flange; pilosity of thorax black. Petiole: black, slightly bulging ventrally on posterior half. Abdomen: first two and anterior half of third segments red, rest of abdomen dark bluish-black.

Female.—Length 14 mm. Head: clypeus quite bulging in middle dorso-ventrally, bulge receding quite strongly above; clypeus with many large deep punctures, a few small punctures; surface of dorsal and lateral areas shallowly reticulate, rest of clypeus glossy; clypeal margin with a small tooth far out on each side. Petiole: about as long as hind coxa. Abdomen: first segment dark blue-black with a red border, second and third red with some dorsal black markings, the third with a black posterior border, rest of abdomen dark blue.

Redescribed from a male collected at Las Vegas, New Mexico, now located in the collection of Massachusetts State College, and from a female collected at Starkville, Colorado, June 13, 1919, now located in the collection of the American Museum of Natural History at New York. Both were compared with the type located in the British Museum (Natural History) by R. B. Benson.

Holotype.—Female, Northern Sonora, Mexico (Morrison). It is located in the British Museum (Natural History), London. In the British Museum is a female labelled "*Ammophila morrisoni* Cam. Type" which is not that species at all but is a female *sonorensis*, this having been determined by Dr. R. B. Benson.

Allotype.—Male, Northern Sonora, Mexico (Morrison). This was apparently deposited in this museum, but, according to Fernald, all that remains is a mount of the genitalia.

Specimens examined: 2 ♂, 1 ♀; total specimens 3.

COLORADO: Westcliff, ♂ [HF].

This species is related to *communis*, though the relationship is not a very close one. The female can be distinguished from *communis* by the small clypeal teeth and the red on the abdomen. The male can be distinguished from the male of *communis* as follows.

In *sonorensis*: clypeus slightly reflexed; pleura with large punctures so numerous and close together as to give a very coarsely reticulated appearance; pilosity of thorax entirely black. In *communis*: clypeus almost flat across central part but bending down to lateral margin; pleura with many punctures which are well separated; pilosity of prothorax and mesonotum may be black, but that of rest of thorax almost always entirely white.

7. *Podalonia sonorensis* subspecies **differentia** new subspecies

(Figure 53)

1927. *Podalonia luctuosa* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 21–26. Male.

1927. *Podalonia argentifrons* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 26–30. Male (in part).

1931. *Podalonia violaceipennis* form *luctuosa* Fernald, Canad. Ent. 63: 278–279. Male.

Male.—Length 10 mm. Head and thorax black. Legs piceous. Abdomen dark bluish-black.

Female.—Length 14 mm. Head and thorax black. Abdomen dark bluish-black.

Holotype.—Male, Troublesome, Colorado, June 9, 1908 (S. A. Rohwer), located in the United States National Museum at Washington, D. C.

Allotype.—Female, Yellowstone Nat. Park, Wyoming, July 9, 1930, located in the American Museum of Natural History, New York.

Specimens examined: 5 ♂, 2 ♀; total specimens 7.

Paratypes.—

COLORADO: Powderhorn, ♂, June 23, 1926 (E. G. Anderson) [UM].

MONTANA: ♀ [AES].

NORTH DAKOTA: Bowman, ♂, June 23, 1918 (O. A. Stevens) [OS].

ALBERTA: Lethbridge, 2 ♂, June 5, 29, 1922 (W. Carter) [CNM, UM].

Variations.—The piceous color of the legs of the holotype is merely a superficial variation. The abdomen is sometimes decidedly bluish. Male: length 10–12 mm.

Except for the color differences of the abdomen, this subspecies is identical with *sonorensis* in all important characters, including the male genitalia. Since both *sonorensis* and *differentia* occur over a wide but scarcely overlapping geographical range, and because of the lack of any structural differences, it is believed best to consider them as subspecies of the same species.

The holotype male has caused confusion by the belief that it was the long sought male of *luctuosa*. It was caught at the same time and place as a female of *communis*, but it was not in copulation with it and has no connection with that species. The male resembles *communis* subspecies *intermedia* superficially, but differs by the same structural characters that separate *sonorensis* from *communis*. The female resembles *communis* and *luctuosa*, but is easily distinguished by the shape of the clypeus and by the clypeal teeth.

8. *Podalonia melaena* new species

(Figures 9, 37, 40, 51)

1927. *Podalonia argentifrons* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 26-30. Male, female (in part).

?1927. *Podalonia luctuosa* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 21-26. Female (in part).

Male.—(See figure 9 for genitalia.) Length 19 mm. Head: clypeal margin very broadly truncate, a very slight central emargination; distal part of clypeus prominently reflexed; frontal suture distinct to anterior ocellus, though weaker in the slight frontal depression; frontal depression finely reticulate and with tiny punctures, rest of frons similar but with many large punctures; pilosity of head black. Thorax: collar rather narrowly rounded; mesopleuron with many deep large punctures; from some of the tiny punctures arise short white sericeous hairs; mesopleuron very finely and indistinctly reticulate and moderately glossy; metapleuron with deep large punctures arranged more or less in rows, coarse flat-topped ridges between most of these rows, this flat surface rather glossy and with occasional tiny punctures; propodeal side with large punctures more numerous than on metapleuron, in more regular rows, and with ridges more numerous, more regular, and more sharply defined; metanotal flange moderate in size; pilosity of thorax black or bluish-black. Petiole: black, long, curved slightly before junction with first abdominal tergite. Abdomen: entirely black with no bluish reflection; white sericeous hairs quite abundant on latter part of first, all of second, and anterior part of third tergites.

Female.—Length 17 mm. Head: clypeus only slightly bulging in center, large punctures irregular in size and shape, most numerous on sides, tiny punctures scattered, surface weakly reticulate. Thorax: short ridges anterior to most of the large punctures on mesothorax, very few tiny punctures on

this plate; surface of entire pleura rather glossy. Abdomen: slender, black, but in certain lights several of the segments, especially the fourth and fifth, may have an almost indiscernible bluish tint.

Holotype.—Male, Boulder, Colorado, July 3, 1922; it is located in the American Museum of Natural History at New York.

Allotype.—Female, Kits Peak Rincon Baboquivari Mts., Arizona, Aug. 1-4, 1916; it is located in the American Museum of Natural History, New York.

Specimens examined: 11 ♂, 7 ♀; total specimens 18.

Paratypes.—

ARIZONA: Santa Cruz Village, Cobabi Mts., ♀, Aug. 10-12, 1916 [AMNH]; Tucson, ♂ (F. H. Snow) [KU]; Tucson, ♂, Oct. 2-25, 1916 [AMNH]; Tucson, ♀, June, July 1910 (Bridwell) [USNM]; Tucson, 18 mi. S., ♀, July 31, 1924 (E. P. Van Duzee) [CAS]; Tucson, Sabino Cyn., ♀, Oct. 17, 1936 (E. P. Van Duzee) [UM].

CALIFORNIA: Descanso, San Diego Co., ♀, Aug. 14, 1917 [JB]; Moke-lumne Hill, ♂ (Bridwell) [USNM]; Pasadena, ♀, May 5, 1928 (C. H. Hicks) [CH].

COLORADO: Jim Creek nr. Boulder, ♂, July 25, 1922 [AMNH].

IDAHO: Warren, Idaho Co., ♂ [RD].

NEVADA: 3 ♂ [AES, UM].

NEW MEXICO: Alamogordo, ♂, May 13, 1902 [AES].

WASHINGTON: Pine Canyon, Brookside Sunset Trail, Orondo, ♂, June 24, 1918 (A. C. Burrill) [WSC].

Variations.—Male: length 14.5-19 mm.; clypeal margin sometimes transverse with no central emargination; rarely clypeus but slightly reflexed; frontal depression occasionally quite distinct; in one specimen metapleuron not ridged, surface between punctures distinctly though finely reticulate posteriorly, smooth anteriorly; first several abdominal segments rarely with a very slight reddish tint. Female: length 17-18 mm.

The entirely black abdomen distinguishes this species from the *argentifrons* group, and the metanotal flange separates it from the *luctuosa* group. The female *melaena* resembles *mexicana* in the shape of the clypeus, and this along with other resemblances probably indicates a relationship between these two species. In *melaena*: abdomen black; metapleuron glossy, with flat-topped ridges and large distinct punctures. In *mexicana*: abdomen always distinctly blue or blue-black; metapleuron moderately or slightly glossy, with distinct, sharply-defined ridges, medium-sized punctures.

9. *Podalonia puncta* new species

(Figures 4, 36, 56)

1865. *Ammophila luctuosa* Cresson, Proc. Phila. Ent. Soc. 4: 462. Female (in part).
 ?1902. *Psammophila luctuosa* Melander & Brues, Biol. Bul. 3: 40-42. Female (in part).
 ?1903. *Ammophila luctuosa* Melander, Psyche 10: 156-164. Female (in part).
 ?1903. *Ammophila violaceipennis* Melander, Psyche 10: 156-164. Male (in part).
 1917. *Psammophila luctuosa* Mickel, Univ. Nebr. Studies 17: 87-88. Female (in part).
 1927. *Podalonia argentifrons* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 26-30. Female (in part).
 1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30-37. Male (in part).

Male.—(See figure 4 for genitalia.) Length 14 mm. Head: clypeal margin extending downwards and slightly inwards for a distance, then bending and extending slightly more inwards for about an equal distance, then bending and extending slightly upwards to center; frontal suture almost completely obsolete, evident below frontal depression but not evident in depression; frontal depression only slightly lower than rest of frons, well marked by complete absence of large punctures, these punctures being very abundant elsewhere on frons; large punctures of frons smaller and closer together towards compound eyes; frontal depression reticulate and with a few tiny punctures; pilosity of head very dense, black. Thorax: all pleura very heavily punctured, these punctures usually so close together as to leave a very narrow ridge between them; on mesopleuron these punctures somewhat more separated, leaving some flat surface between them; metanotal flange medium; pilosity very dense, black. Petiole: black. Abdomen: all of first except base, all of second, and anterior two-thirds of third segments yellowish-red; base of first segment black; remainder of abdomen bluish.

Female.—Length 16 mm. At first glance appearing quite different from male; structurally, however, practically identical except for the usual sexual differences. Head: clypeus considerably bulging centrally from top to bottom, not much from side to side, upper edge well marked; surface of clypeus glossy, with a great many large round punctures from which strong pilose hairs arise; frontal suture obsolescent in frontal depres-

sion, though with a thin line visible to anterior ocellus. Abdomen: blue.

Holotype.—Male, Alamogordo, New Mexico, April 22, 1902. It is in the collection of the American Entomological Society, Philadelphia, Pa.

Allotype.—Female, Hamilton Co., Kansas (F. H. Snow). It is deposited in the collection of the University of Kansas, Lawrence, Kansas.

Specimens examined: 5 ♂, 22 ♀; total specimens 27.

Paratypes.—

COLORADO: ♀ [AES]; Lamar, 2 ♀, June 4–11, 1919 [AMNH, UM]; Russell, 2 ♀, July 12 (H. S. Smith) [UN]; Ute Creek, 2 ♀, July 3 (L. Bruner) [UN]; Ute Creek, 2 ♀, June 24 (H. S. Smith) [UN]. KANSAS: Clark Co., ♂, Aug. 26, 1911 (F. X. Williams) [KU]; Garden City, 2 ♀, June 1895 (H. W. Menke) [MCZ]; Hamilton Co., 6 ♀ (F. H. Snow) [KU]; Meade Co., ♀, May 16 [KSC].

NEW MEXICO: Clouderoft, ♂, Aug. 3–10, 1903 (W. Knaus) [USNM]; Las Vegas, 25 mi. N. of, ♀, June 28, 1931 (H. A. Scullen) [OAC]; Mesilla, ♂, April 10, 1909 (C. N. Ainslie) [AES].

OKLAHOMA: Ardmore, ♀, June 1, 1909 (F. C. Bishopp) [AES].

TEXAS: ♀ [AES]; ♂ [UM].

Variations.—Male: length 10–14 mm.; clypeal margin somewhat variable; occasionally margin extending downwards and slightly inwards only a very short distance before bending considerably more inwards, this second part extending a considerable distance before bending inwards and slightly upwards to center; rarely first bend scarcely evident, in this case the margin bearing a resemblance to the margin in some males of *communis*. Female: length 13–18 mm.; metapleuron sometimes more or less clearly ridged rather than coarsely reticulated; sometimes with slight ridges anterior to some of punctures of mesopleuron; rarely clypeus only slightly bulging.

The color combination of the abdomen of the male and female makes this a very unusual species. The bluish abdomen of the female shows that this species belongs to the *argentifrons* group, but the male is unusual in being the only one of this group in which the abdomen is partly red. The male is distinctive from all other known species of *Podalonia* by the shape of the clypeus, the very heavy punctation of the head and thorax, and the red and blue abdomen. The female can be distinguished from other species in the *argentifrons* group by the highly glossy, moderately bulging clypeus, this plate bearing a great many rather uniformly-sized large round punctures, by the smooth frontal depression, and by the weak frontal suture, especially in the frontal depression.

10. *Podalonia argentifrons* (Cresson)

(Figures 7, 38, 52)

1865. *Ammophila argentifrons* Cresson, Proc. Phila. Ent. Soc. 4: 462-463. Male (in part).
- ?1888. *Ammophila argentifrons* Cameron, Biol. Centr.-Amer., Hym. 3: 23.
- ?1902. *Psammophila luctuosa* Melander & Brues, Biol. Bul. 3: 40-42. Female (in part).
- ?1902. *Psammophila argentifrons* Melander & Brues, Biol. Bul. 3: 40-42. Male (in part).
1903. *Ammophila luctuosa* Melander, Psyche 10: 156-164. Male, female (in part).
1908. *Psammophila luctuosa* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Male, female (in part).
1917. *Psammophila luctuosa* Mickel, Univ. Nebr. Studies 17: 87-88. Male, female (in part).
1927. *Podalonia argentifrons* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 26-30. Male, female (in part).

Male.—(See figure 7 for genitalia.) Length 14 mm. Head: clypeal margin extending downwards and slightly inwards for a short distance, then bending and extending more inwards for a slightly greater distance, finally bending to extend transversely to center, a slight emargination at center; clypeus scarcely bulging; frontal suture so wide as to be marked by a double line, except just in front of anterior ocellus, where it becomes obsolescent; frontal depression moderately deep, surface reticulate and without punctures; frons with many large, slightly elongated punctures, a moderate number of small punctures between the large ones; large punctures about their diameters apart for a short distance above antennae; pilosity of head black. Thorax: mesopleuron with a great many deep, large punctures, some more or less confluent, almost no small punctures, surface weakly reticulate; metapleuron and propodeal side with large punctures so abundant and close together as to give a coarsely reticulated appearance to these plates; metanotal flange rather small; pilosity of thorax black. Abdomen bluish-black.

Female.—Length 14 mm. Head: clypeus moderately bulging centrally, turning down abruptly near margin, not bulging laterally; clypeus with a good many large punctures which vary in size from average-sized large ones down to small ones, very few tiny punctures, surface reticulate; frontal suture very wide; frons with a great many deep large punctures, surface

granulate. Thorax: metapleuron and propodeal side with some distinct slanting ridges.

Redescribed from a male and a female which have been compared with the holotype. Male, Halsey, Nebraska, Aug. 16, 1925 (R. W. Dawson); female, Halsey, Nebraska, Aug. 29, 1924 (R. W. Dawson). Both are located in the collection of the University of Minnesota.

Holotype.—Male, Colorado Territory. It is in the collection of the American Entomological Society, Philadelphia, Pa.

Allotype.—Female, March 9, 1916 (E. O. Van Duzee). Fernald designated the allotype in 1927. It is located in the collection of the California Academy of Sciences. The writer was unable to examine the allotype.

Specimens examined: 62 ♂, 60 ♀; total specimens 122.

Argentifrons has been collected in the following states and provinces: NORTH DAKOTA, SOUTH DAKOTA (July 22–Sept. 9), NEBRASKA, MONTANA, WYOMING, COLORADO (May 16–Aug. 19), NEW MEXICO (Apr. 10), UTAH, ARIZONA, IDAHO, NEVADA, OREGON, CALIFORNIA (Mar.–Dec. 3), MANITOBA, ALBERTA.

Variations.—Rarely frontal suture narrow and similar to *mexicana*. Male: length 12–16 mm.; clypeal margin somewhat variable; punctures on propodeal side and metapleuron, and rarely on mesopleuron, sometimes so close together as to give a very coarsely reticulated appearance to these plates. Female: length 13–17 mm.; clypeus somewhat variable, occasionally resembling *mexicana* with regards to the amount of bulge and character of punctation.

This species is very closely related to *mexicana*. The most useful characters to use in separating these two species are given following the description of *mexicana*.

11. *Podalonia mexicana* (Saussure)

(Figures 6, 26, 41, 66)

1865. *Ammophila argentifrons* Cresson, Proc. Phila. Ent. Soc. 4: 462–463. Male (in part).

1865. *Ammophila luctuosa* Cresson, Proc. Phila. Ent. Soc. 4: 462. Female (in part).

1867. *Ammophila mexicana* Saussure, Reise d. Novara, Zool. 2, pt. 1, Hym., p. 25. Male, female.

?1888. *Ammophila argentifrons* Cameron, Biol. Centr.-Amer., Hym. 3: 23.

?1902. *Psammophila luctuosa* Melander & Brues, Biol. Bul. 3: 40–42. Male, female (in part).

?1902. *Psammophila argentifrons* Melander & Brues, Biol. Bul. 3: 40–42. Male, female (in part).

1903. *Ammophila luctuosa* Melander, Psyche 10: 156-164.
Male, female (in part).
1908. *Psammophila luctuosa* H. S. Smith, Univ. Nebr. Studies
8: 330-331. Male, female (in part).
1917. *Psammophila luctuosa* Mickel, Univ. Nebr. Studies 17:
87-88. Male, female (in part).
1925. *Psammophila luctuosa* Carter, Canad. Ent. 57: 131-136.
Male only (in part).
1927. *Podalonia argentifrons* Fernald, Proc. U. S. Nat. Mus.
71, Art. 9, pp. 26-30. Male, female (in part).

Male.—(See figure 6 for genitalia.) Length 14 mm. Head: clypeal margin extending downwards and somewhat inwards a short distance, then bending sharply and extending almost transversely but slightly downwards for a shorter distance, then bending slightly and extending transversely to center, curving gently upwards near center to form a shallow emargination; clypeus very slightly bulging; frontal suture not sharply defined; frontal depression moderate in size, not well defined; surface immediately in front of anterior ocellus with smooth reticulation, elsewhere frons with only a few well-scattered large punctures and a great many tiny punctures which extend up to frontal suture except immediately in front of anterior ocellus; pilosity of head black. Thorax: collar moderately rounded; mesopleuron with many large punctures which have a slight tendency to form rows, short ridges in front of most of the punctures; a few small punctures on plate, some of these with very short sericeous hairs, surface of plate distinctly reticulate; metapleuron and propodeal side with large punctures tending to elongate, more or less lined up in rows with ridges between; metanotal flange moderate; most of thoracic pilosity white with black bases. Abdomen: dark blue.

Female.—Length 15 mm. Head: clypeus slightly bulging, central part not much more so than lateral parts, lower part descending rather quickly to margin; a moderate number of large and medium-sized punctures but no small punctures, surface reticulate; frontal suture distinct to ocellus; frons with only a few large punctures except near eyes, these punctures somewhat elongated, a great many shallow tiny punctures, surface reticulate. Thorax: metapleuron and propodeal side with much stronger ridges than in male.

Redescribed from a male and a female which were compared with the lectotype and lectoallotype respectively; both are in the collection of the University of Minnesota. Male, Beach, North Dakota,

Aug. 16, 1921 (C. N. Ainslie); female, Flagstaff, Arizona, June 30.

Lectotype.—Male, Cordova t.c., Cn. de Saussure.

Lectoallotype.—Female, Cordova t.c., Cn. de Saussure. The lectotype and lectoallotype, along with the other specimens of Saussure's type series, are located in the Museum of Natural History of Geneva, Geneva, Switzerland.

Specimens examined: 237 ♂, 195 ♀; total specimens 432.

Mexicana has been collected in the following states, provinces and countries: NORTH DAKOTA, NEBRASKA, KANSAS, MONTANA, WYOMING, COLORADO (May 17–Oct. 8), NEW MEXICO, UTAH, ARIZONA, IDAHO, NEVADA, WASHINGTON (May 15–Sept. 10), OREGON, CALIFORNIA, SASKATCHEWAN, ALBERTA (May 13–Sept. 9), BRITISH COLUMBIA, MEXICO.

Variations.—Frontal suture occasionally so broad as to be similar to the condition in *argentifrons*; surface of mesopleuron occasionally strongly ridged; rarely metanotal flange quite small; sometimes tiny punctures on frons very few in number. Male: length 10–15 mm.; shape of clypeal margin somewhat variable; mesopleuron sometimes with short prominent ridges, and ridges of metapleuron and propodeal side may be quite strong; thoracic pilosity sometimes entirely black. Female: length 13–18 mm.; occasionally clypeus almost flat; clypeus sometimes smooth and highly glossy, in other cases more or less finely reticulate and dull; number of punctures on clypeus somewhat variable, though number of large punctures usually small; rarely clypeus resembling that of *argentifrons*.

Mexicana and *argentifrons* are very closely related, but are reliably separated by a number of characters. In the male *mexicana*: largest punctures of frons between antennal bases below, anterior ocellus above, and compound eyes on each side are rather few in number and well separated, and tiny punctures are well distributed between the larger ones, especially noticeable in region of frontal suture; frontal suture only a thin line, sometimes more or less obsolescent; metapleuron more or less prominently ridged, with large punctures rather shallow, more or less elongated, and moderately abundant. In the male *argentifrons*: largest punctures of frons very numerous about halfway between antennae and anterior ocellus, less than their diameters apart and sometimes even touching each other; frons usually quite granulate, small punctures almost entirely absent; frontal suture usually so wide as to form a trough; metapleuron and propodeal side with large punctures so abundant and close together as to give a coarsely reticulated appearance to these plates. In the female *mexicana*: frons with largest punctures well separated, usually, though not always, with some tiny punctures

between the large ones; frontal suture as in male; clypeus with large punctures sparsely scattered, surface more or less glossy and only slightly bulging; thoracic pleura moderately punctate, more or less prominently ridged. In the female *argentifrons*: frontal suture as in male except usually somewhat deeper; clypeus usually conspicuously reticulate, bulging considerably in central portion and receding rather rapidly to distal margin; large punctures of clypeus more numerous than in *mexicana*; thoracic pleura very coarsely punctate, occasionally ridged.

12. *Podalonia valida* (Cresson)

(Figures 14, 31, 43, 59)

1865. *Ammophila valida* Cresson, Proc. Phila. Ent. Soc. 4: 461. Female.
1872. *Ammophila grossa* Cresson, Trans. Amer. Ent. Soc. 4: 209. Female.
- ?1874. *Ammophila quadridentata* Fox, Proc. Calif. Acad. Sci. 4: 101, ser. 2. Female.
- ?1902. *Psammophila grossa* Melander & Brues, Biol. Bul. 3: 40-42. Male, female.
1902. *Psammophila valida* Melander & Brues, Biol. Bul. 3: 40-42. Female.
1903. *Ammophila grossa* Melander, Psyche 10: 156-164. Male, female (in part).
1903. *Ammophila valida* Melander, Psyche 10: 156-164. Female.
- ?1908. *Psammophila grossa* H. S. Smith, Univ. Nebr. Studies 8: 330. Male, female (in part).
1917. *Psammophila valida* Mickel, Univ. Nebr. Studies 17: 87. Male, female.
1924. *Psammophila valida* Carter, Ent. News 35: 365. Male.
1925. *Psammophila valida* Carter, Canad. Ent. 57: 132. Male, female.
1927. *Podalonia valida* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, p. 17. Male, female (in part).

Male.—(See figure 14 for genitalia.) Length 20 mm. Head: clypeal margin extending downwards and somewhat inwards for some distance, then bending and extending almost transversely but slightly downwards to center, which is marked by a slight emargination; clypeus slightly bulging above middle, slightly concave below middle; frontal suture distinct to anterior ocellus, a slight depression before the ocellus; area between lateral ocelli and compound eyes depressed below rest of frons and vertex; entire frons with silvery sericeous hairs;

head with pilose hairs mostly black basally and white apically, though with some hairs all black and with some all white. Thorax: collar moderately rounded; mesopleuron prominently reticulate, with many large round punctures; metapleuron with large punctures tending to elongate posteriorly, some coalescing, but not much indication of ridges; propodeal side with a great many large punctures, with ridges between some of these punctures; metanotal flange moderate in size and with a weak emargination; pilose hairs of prothorax black basally and white apically, otherwise thoracic pilosity entirely white. Legs: a spur at apex of fore coxa within. Petiole: long, black, posterior part curving upwards slightly. Abdomen: first segment red except for black dorsal line, second and third entirely red, fourth red with a broad black dorsal stripe which widens posteriorly, fifth and sixth black dorsally and red ventrally, seventh black.

Female.—Length 24 mm. Head: clypeus strongly bulging in center, area between bulge and margin rather glossy; margin with two strong lateral teeth which divide the margin into approximately thirds, irregular small teeth between these two large teeth; clypeal margin with central emargination; pilosity of head black. Thorax: punctures of metapleuron joined by distinct ridges; pilosity of thorax black. Abdomen: entirely red.

Redescribed from a male and a female located in the collection of the University of Minnesota; male, Dickenson, North Dakota (C. N. Ainslie); female, Kittson Co., Minnesota, Aug. 6, 1936 (D. G. Denning). The female was compared with the holotype.

Holotype.—Female, Colorado Territory; it is located in the collection of the American Entomological Society, Philadelphia, Pa.

Allotype.—Male, Lethbridge, Alberta, Aug. 6, 1923 (H. L. Seaman); designated by Walter Carter and now located in the Canadian National Museum, Ottawa.

Grossa was described by Cresson from a female collected in Texas by L. Heiligbrodt. The holotype is in the United States National Museum. In 1902 Melander and Brues described the male of *grossa* from two specimens collected at Austin, Texas, and one of these specimens was designated as allotype. This allotype is in the collection of Washington State College, Pullman, Washington.

Specimens examined: 73 ♂, 90 ♀; total specimens 163.

Valida has been collected in the following states and provinces: MINNESOTA (Aug. 7–Sept. 26), IOWA, NORTH DAKOTA (June 19–Sept.), SOUTH DAKOTA, NEBRASKA, KANSAS, TEXAS (April 13–May

10), MONTANA, COLORADO (July 1–Sept. 7), NEW MEXICO, UTAH, ARIZONA, WASHINGTON (May), CALIFORNIA, SASKATCHEWAN, ALBERTA (July 27–Sept. 15), BRITISH COLUMBIA.

Variations.—Rarely fore-coxal tooth very small and blunt, being represented by a slight elevation only at location where tooth is normally present; metapleuron and propodeal side sometimes with flat glossy areas between punctures; sometimes these plates regularly ridged. Male: length 16–22 mm.; head pilosity entirely black in some specimens; clypeus sometimes scarcely bulging. Female: length 16–24 mm.; clypeal teeth vary in number and size, even on opposite sides of the same specimen; rarely with petiole red; occasionally several posterior abdominal segments black, this condition being caused in at least one specimen by *Stylops*.

Cresson apparently believed that *grossa* was not conspecific with *valida* because of the fact that the posterior part of the abdomen was black in *grossa*, while in *valida* the abdomen was entirely red. The writer agrees with Fernald in placing *grossa* in synonymy with *valida*. Many species of *Podalonia* vary in the extent of red on the abdomen, and color as a specific character is misleading. A study of the structure reveals the true situation. For distinctions between *valida* and *montana*, see the notes following the description of *montana*.

13. *Podalonia montana* (Cameron)

(Figures 11, 32, 59)

1888. *Ammophila montana* Cameron, Biol. Centr.-Amer., Hym. 2: 20. Male.
 1888. *Ammophila jason* Cameron, Biol. Centr.-Amer., Hym. 2: 20. Female.
 ?1888. *Ammophila quadridentata* Cameron, Biol. Centr.-Amer., Hym. 2: 23. Female.
 ?1894. *Ammophila quadridentata* Fox, Proc. Calif. Acad. Sci. 4: 101, ser. 2. Female.
 ?1903. *Ammophila quadridentata* Melander, Psyche 10: 156–164. Female.
 ?1903. *Ammophila jason* Melander, Psyche 10: 156–164. Female.
 ?1903. *Ammophila montana* Melander, Psyche 10: 156–164. Male.
 1927. *Podalonia valida* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 13–16. Male, female (in part).
 1927. *Podalonia quadridentata* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, p. 17. Female.

(To be concluded in number 2)

VOL. XX (New Series)

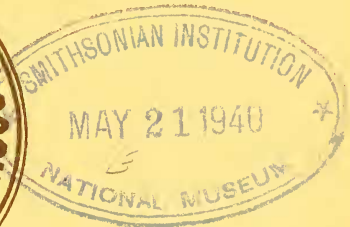
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No. 2

PODALONIA (HYMENOPTERA: SPHECIDAE) OF NORTH AND CENTRAL AMERICA

BY WILLIAM DONALD MURRAY

(Continued from number 1)

Male.—(See figure 11 for genitalia.) Length 20 mm. Head: clypeal margin extending downwards and somewhat inwards for some distance, then bending and extending almost transversely but slightly downwards to center, this marked by a slight emargination; clypeus slightly bulging above middle, slightly concave below middle; frontal suture becoming obsolete in front of anterior ocellus; almost no frontal depression whatever; frons with a great many tiny punctures, especially along frontal suture, and with many large punctures; pilosity of head black, a few hairs white. Thorax: collar moderately rounded; mesopleuron with many large round punctures and with a great many tiny punctures from which short white sericeous hairs arise, surface rather glossy and not conspicuously reticulate; metapleuron and propodeal side with many large punctures, some forming rows and with ridges between them; only a small amount of surface between the large punctures, this with tiny punctures and somewhat glossy; a small, rather inconspicuous pubescent patch on propodeum on each side of petiole attachment; metanotal flange moderately large; pilosity of prothorax and mesonotum mostly black, of rest of thorax white. Legs: no spur whatever at apex of fore coxa within. Abdomen: first two segments red with a black dorsal stripe, third segment red on ventral half, black on dorsal half, rest of abdomen black.

Female.—Length 20 mm. Head: clypeus with two broad emarginate teeth; clypeus quite bulging in center, margin appearing slightly reflexed; area between bulge and marginal teeth very glossy and almost without punctures, elsewhere clypeus with many large and small punctures and with a moderately glossy surface; frontal suture quite distinct except in front of anterior ocellus, where it disappears in the short but wide frontal depression; pilosity of head black. Thorax: mesopleuron with a great many very large punctures, leaving only a small amount of intervening surface; these punctures, even where coalescing, not forming rows to any extent; surface between punctures with only a few small punctures and with a distinct reticulation; large punctures of propodeal side so numerous as to leave almost no intervening space, thus giving a very coarsely reticulated appearance to this plate; pilosity of thorax black except on propodeal disk where there are a few long white hairs. Abdomen: entirely dark red.

Redescribed from a male and a female which were compared by Dr. R. B. Benson with the holotypes of *montana* and of *jason* respectively. Male, female, Xucumanatlán, Guerrero, July (H. H. Smith), P. Cameron collection. They are located in the British Museum (Natural History) in London.

Holotype.—Male, Mexico, Ventanas in Durango (Forrer).

Allotype.—The holotype of *jason* is herein designated as the allotype of *montana*; female, Guatemala, San Gerónimo (Champion). The holotype and allotype are located in the British Museum (Natural History) in London. The holotype of *quadridentata* was collected in Mexico, Ventanas in Durango (Forrer), and is also located in the British Museum.

The specimens which Dr. R. B. Benson compared with *montana* and *jason*, and which were studied by the writer, are undoubtedly the male and female of the same species. This is based on a study of the structure of those two specimens. Dr. Benson studied the holotype of *quadridentata* and stated (in lit.) that it agrees very closely with *jason* except that the propodeal side is punctured between transverse striae, whereas it is densely punctured without transverse striae in *jason*. Individual variation might easily account for this difference, and the writer believes that *jason* and *quadridentata* are only slight variations of the same species. This species receives the name *montana* through page priority.

Specimens examined: 1 ♂, 2 ♀; total specimens 3.
MEXICO: ♀ [USNM].

The male of *montana* resembles closely the male of *valida*, from which it is distinguished by the absence of a fore-coxal spur, by differences in punctuation, and by the genitalia. The female is distinguished from *valida* by the absence of a fore-coxal spur, and from *clypeata* by the much larger size and strongly fuliginous wings, as well as by differences in punctuation. See also the note following the description of *pubescens*.

14. *Podalonia pubescens* new species

(Figures 13, 42, 55)

1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30-37. Male, female (in part).

Male.—(See figure 13 for genitalia.) Length 17 mm. Head: clypeal margin extending downwards and inwards for a short distance, then bending and extending almost transversely but slightly downwards to center, this being marked by a slight emargination; clypeus somewhat bulging in center, very slightly concave below bulge, giving it a slightly reflexed appearance; frontal suture distinct for only a short distance above base of antennae; frontal depression moderately large and deep, with the area immediately anterior of ocellus glossy and inconspicuously reticulate, otherwise with small punctures; rest of frons with large and small punctures and with a glossy surface; pilosity of head black. Thorax: collar moderately rounded; mesopleuron with large punctures well-spaced, with a great many tiny punctures which become more numerous below and from which white sericeous hairs arise; surface of mesopleuron very glossy; metapleuron with large punctures much closer together, many coalescing, but with considerable surface evident, this surface with a few tiny punctures and highly glossy; propodeal side with large punctures very close together, leaving almost no surface in between; on posterior part of this plate tiny punctures much more numerous, and sericeous hairs arise from them, these being so long and abundant as to form a conspicuous pubescent patch; metanotal flange moderate in size; pilose hairs of thorax mostly white with black bases. Petiole: very long and slender, curved slightly beyond middle. Abdomen: first segment red with a black dorsal stripe, second and third segments red, rest of abdomen black with a dark bluish tint.

Female.—Length 19 mm. Head: clypeal margin with a conspicuous central indentation; clypeus moderately bulging

in center, with a great many medium-sized and small punctures, surface glossy; frons, especially laterally, with a great many medium-sized punctures; grayish-brown sericeous hairs on clypeus and frons; pilosity of head black. Thorax: pilosity black except on propodeum, this plate with hairs black with white tips. Abdomen: entirely red.

Holotype.—Male, Post Creek Canyon, Pinaleno Mts., Fort Grant, Arizona, July 15–18, 1917. The holotype was donated to the collection of the University of Minnesota by Dr. J. Bequaert.

Allotype.—Female, Big Bend Park, Brewster Co., Texas, July 27, 1937 (Rollin H. Baker). The allotype was donated to the collection of the University of Minnesota, St. Paul, Minn., by Mr. Baker.

Specimens examined: 12 ♂, 12 ♀; total specimens 24.

Paratypes.—

ARIZONA: Huachuca Mts., ♀, July 8, 1932 (R. H. Beamer) [KU]; Huachuca Mts., Carr Cyn., ♂, June 6, 1930 (G. Linsley) [CAS]; Palmerlee, ♂ (N. Banks) [MCZ]; Post Creek Cañon, Pinaleno Mts., Fort Grant, ♂, ♀, July 15–18, 1917 [JB]; Santa Rita Mts., 7 ♂, 6 ♀, June, July (F. H. Snow) [KU, UM].

TEXAS: Big Bend Park, Brewster Co., ♂, ♀, July 24, 27, 1937 (R. H. Baker) [RB].

MEXICO: Canon del Hillcoat, Sierra del Carmen, Coah, ♀, July 10, 1938 (R. H. Baker) [RB]; Chihuahua City, ♀, Aug. 16–18, 1906 (P. P. Calvert) [HF].

Variations.—Male: length 15–18 mm.; clypeal margin somewhat variable, in some cases with a broad central emargination; propodeal side sometimes with some surface between the punctures. Female: length 16–22 mm.; large punctures on upper part of frons occasionally elongated. One female which was stylopized shows strong tendencies towards maleness; the dorsal part of the third and fourth, and all of the fifth and sixth segments are black, and the sericeous hairs of the head and pleura are more developed than usual for the females.

The prominent pubescent patches on the propodeal end are very distinctive for this species. The male of *montana*, however, has a slight patch on the propodeum on each side of the petiole attachment, and also conspicuous sericeous hairs on the pleura, and might cause confusion. The shape of the clypeus is useful in separating the males of these two species, being more nearly flat in *montana* and with the margin more smoothly bending laterally and with a broader transverse section. The genitalia of these two species are

quite similar. The female of *montana* is at once distinguished from the female of *pubescens* by the toothed clypeus.

15. *Podalonia clypeata* new species

(Figures 10, 27, 33, 54)

?1908. *Psammophila grossa* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Female (in part).

?1908. *Psammophila violaceipennis* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Male (in part).

1917. *Psammophila grossa* Mickel, Univ. Nebr. Studies 17: 87-88. Female (in part).

1917. *Psammophila violaceipennis* Mickel, Univ. Nebr. Studies 17: 87-88. Male (in part).

1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30-37. Male (in part).

Male.—(See figure 10 for genitalia.) Length 14 mm. Head: clypeal margin extending downwards and somewhat inwards for a short distance, then bending and extending farther inwards for a longer distance, this part with a very slight upward curve, then bending inwards to the middle, with a conspicuous central emargination; clypeus strongly bulging in center, distinctly concave between center and margin; frontal suture moderately strong; frontal depression very small, evident immediately in front of anterior ocellus only; frons with many large punctures and a great many tiny ones, surface glossy, pilosity of head black. Thorax: collar moderately rounded; mesopleuron with large punctures abundant and quite deep and distinct, and with scattered tiny punctures, surface with smooth reticulation, almost glossy; metapleuron with a great many large punctures, some tending to form rows, almost no tiny punctures; anteriorly with surface glossy, posteriorly reticulated and weakly ridged; propodeal side with large punctures extremely numerous and forming more or less distinct rows separated by ridges, surface between punctures glossy; metanotal flange very large, slightly emarginate; pilosity of thorax entirely black. Wings: almost hyaline. Abdomen: first two segments red, third red except for a narrow posterior band, rest of abdomen black; abdomen somewhat compressed, rather unusual for the genus.

Female.—Length 15 mm. Head: clypeal margin with two broad emarginate teeth; clypeus quite bulging in center, with many large and tiny punctures, surface faintly reticulate later-

ally, glossy elsewhere; pilosity of head black. Wings: moderately fuliginous. Abdomen: with the slightly compressed appearance as in male; first three and anterior half of fourth segments bright orange-red, rest of abdomen black.

Holotype.—Male, Halsey, Nebraska, Aug. 29, 1924 (R. W. Dawson); it is deposited in the collection of the University of Minnesota, St. Paul, Minn.

Allotype.—Female, Middle River, Minnesota, Aug. 9, 1935 (D. G. Denning); it is deposited in the collection of the University of Minnesota.

Specimens examined: 11 ♂, 24 ♀; total specimens 35.

Paratypes.—

KANSAS: ♀ [AES]; ♀, Aug. 28, 1898 [AES]; Graham Co., ♀, Aug. 16, 1912 (F. X. Williams) [KU]; Phillips Co., ♀, Aug. 30, 1912 (F. X. Williams) [KU, UM]; Riley Co., ♂, Sept. 11 (G. A. Dean) [UM]; Riley Co., ♂, Sept. 30 (J. B. Norton) [KSC]; Trego Co., ♀, July 12, 1912 (F. X. Williams) [KU]; Wallace, ♀, July 1885 [KSC]; Wichita Co., ♀ (F. X. Williams) [KU].

MINNESOTA: Anoka Co., Sand Dunes, ♀, Aug. 3, 1933 (A. C. Hodson) [UM].

MONTANA: ♀ [AES]; Hamilton, ♂, July 30, 1928 [MSC].

NEBRASKA: Halsey, ♂, 2 ♀, Aug. 11, 14, 15, 1925 (R. W. Dawson) [UM, BM]; Halsey, 2 ♀, Aug. 12, 1912 (J. T. Zimmer) [UN]; Monroe Canon, Sioux Co., 4 ♀, Aug. 3, 21, 1908 (R. W. Dawson) [UN]; Monroe Canon, Sioux Co., ♂, Aug. 9, 1908 (L. Bruner) [UM]; Sioux Co., 2 ♀ [UN]; West Point, 2 ♀ [UN].

OKLAHOMA: Cherokee, ♀, July 4, 1934 (A. E. Pritchard) [OAMC].

OREGON: Camp Umatilla, ♂, June 27, 1882 [MCZ].

WASHINGTON: Colville V., Loon Lake, ♂, July 25, 1882 [MCZ]; Little Spokane, 3 ♂, July 26, 1882 [MCZ, UM].

UNLABELED: ♀, Aug. 28, 1898 [AES].

Variations.—Male: length 14–16 mm.; some variation in extent of red on abdomen; rarely surface of metapleuron mostly wavy, glossy only anteriorly. Female: length 15–18 mm.; wings sometimes almost hyaline; occasionally mesopleuron with moderately strong ridges, the glossy surface being quite reduced in extent; abdomen sometimes very strongly compressed.

The male of this species is most similar to the male of *violaceipennis*. In *clypeata*: clypeal margin conspicuously emarginate in center, curving of margin distinctive as shown in figure 27; only a slight frontal depression, and surface of almost entire frons glossy; almost entire anterior half of metapleuron glossy; metanotal flange

conspicuously but not deeply emarginate. In *violaceipennis*: clypeal margin scarcely if at all emarginate in center; a large and distinct frontal depression, surface of depression finely reticulate and dull; anterior part of metapleuron usually finely reticulate; metanotal flange large and deeply emarginate.

The female of this species is distinct from the females of all other species except *montana* by the shape of the clypeal teeth. The size and shape of the metanotal flange, as well as other structural characters, separate this species from *montana*. Small specimens of *valida* might be confused with this species, but that species has a spur on the anterior coxa.

16. *Podalonia violaceipennis* (LePeletier)

(Figures 16, 22, 49)

1845. *Ammophila violaceipennis* LePeletier, Hist. Nat. Ins. Hym. 3: 370. Female.
1856. *Ammophila violaceipennis* Smith, Cat. Hym. Brit. Mus. 4: 224.
1856. *Ammophila cementaria* Smith, Cat. Hym. Brit. Mus. 4: 224. Female.
1902. *Psammophila violaceipennis* Melander & Brues, Biol. Bul. 3: 40-42.
1902. *Psammophila communis* Melander & Brues, Biol. Bul. 3: 40-42. Male (in part).
1903. *Ammophila violaceipennis* Melander, Psyche 10: 156-164. Male, female (in part).
- ?1903. *Ammophila grossa* Melander, Psyche 10: 156-164. Female (in part).
1908. *Psammophila violaceipennis* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Male (in part).
- ?1911. *Ammophila* sp. Turner, Psyche 18: 13-14. Female.
1915. *Psammophila violaceipennis* Parker, Proc. Ent. Soc. Wash. 17: 70-77. Female.
1917. *Psammophila violaceipennis* Mickel, Univ. Nebr. Studies 17: 87-88. Male, female (in part).
- ?1917. *Psammophila grossa* Mickel, Univ. Nebr. Studies 17: 87-88. Female (in part).
1917. *Psammophila violaceipennis* Rohwer, Conn. Geol. & Nat. Hist. Surv. 22: 681. Male, female (in part).
1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, p. 17. Male, female (in part).

1936. *Podalonia violaceipennis* Balduf, Canad. Ent. 68: 137-138. Female (in part).

?1936. *Podalonia violaceipennis* Krombein, Ent. News 47: 93-99. Female.

Male.—(See figure 16 for genitalia.) Length 16 mm. Head: clypeal margin extending downwards and somewhat inwards for a short distance, then bending and extending inwards for an equal distance, then bending and running almost transversely but slightly upwards to center; clypeus slightly and very broadly depressed above margin, rather bulging on upper part; frontal suture distinct to anterior ocellus; frontal depression moderately deep; surface in frontal depression coarsely granulate, rest of frons with a moderate number of large and a considerable number of tiny punctures, surface more or less finely reticulate; pilosity of head long, dense and black. Thorax: collar broadly rounded; mesopleuron with many large punctures, tiny punctures moderately abundant on lower part of mesopleuron, surface rather dull, reticulate; metapleuron with many large punctures, those on posterior part rather elongated, almost no regular ridges, surface on extreme anterior part smooth and glossy, remainder of plate scratchy and rather dull; propodeal side with many large punctures and broken ridges between them on the lower posterior part; pilosity of thorax entirely black. Petiole: slender. Abdomen: first segment except at base, all of second, all except posterior dorsal part of third segments red, rest of abdomen black.

Female.—Length 16 mm. Head: clypeus bulging only slightly in center, many moderate-sized punctures, surface prominently reticulate giving a dull appearance, tiny punctures very abundant and tending to blend in with the surface reticulation; upper edge of clypeus weakly marked, smoothly rounded. Thorax: surface of metapleuron not as wavy as in male, distinctly reticulate except at extreme anterior end. Petiole: rather slender, length compared with length of hind coxa being 1.27 for petiole to 1 for coxa.

Redescribed from a male and a female in the collection of the University of Minnesota; male, Halsey, Nebraska, Aug. 14, 1925 (R. W. Dawson); female, Hennepin Co., Minnesota, Aug. 5, 1930 (C. E. Mickel).

Holotype.—Female, Philadelphia; located in the Serville collection. C. E. Mickel, while studying in Europe, found that the Serville Hymenoptera collection containing many of LePeletier's types

now forms a part of the Spinola collection. Therefore the type of *violaceipennis* is very probably in the Spinola collection which forms a part of the collections of the Museo Zoologia et Anatomia Comparata della R. Università, Torino, Italy. The holotype of *violaceipennis* has not been seen by any worker on this group since its original description. Since it was collected at Philadelphia, and since only one species of *Podalonia* has ever been taken near this region, this species is given the name *violaceipennis*.

Allotype.—The male described herein is designated as the allotype.

Specimens examined: 94 ♂, 149 ♀; total specimens 243.

Violaceipennis has been collected in the following states and provinces: NEW HAMPSHIRE, MASSACHUSETTS (June 25–Oct. 4), NEW YORK, NEW JERSEY (May 30–Oct. 4), PENNSYLVANIA, DELAWARE, VIRGINIA, NORTH CAROLINA (Apr. 4–Nov. 6), GEORGIA, ALABAMA, FLORIDA, OHIO, INDIANA, ILLINOIS, MICHIGAN, WISCONSIN, MINNESOTA (June 3–Sept. 25), NORTH DAKOTA, SOUTH DAKOTA, NEBRASKA, KANSAS, OKLAHOMA, COLORADO, ONTARIO.

Variations.—Male: length 11–20 mm.; clypeal margin sometimes slightly emarginate in middle, at other times broadly truncate; in one small specimen margin appearing almost rounded; frontal suture usually not distinct its entire length; frontal depression sometimes rather deep, and small punctures sometimes extend over entire depression; area of metapleuron which is glossy varying from only a very small anterior part to about one-third of plate; rarely thoracic pilosity partially white. Female: length 13–20 mm.; in large specimens clypeus occasionally bulging nearly as much as in some specimens of *robusta*; sometimes surface of clypeus with very little reticulation, thus being rather glossy; upper edge of clypeus sometimes showing a very slight tendency towards being V-shaped, but almost never distinctly so. Rarely several punctures on mesopleuron run together and tend to form weak ridges; metapleuron occasionally with short ridges in front of large punctures; length of petiole in comparison with hind coxa somewhat variable, in one specimen this proportion being 1.1 for petiole to 1 for coxa.

Violaceipennis is most closely related to *occidentalis*, *robusta*, *mickeli* and *clypeata*. *Violaceipennis* and *occidentalis* are best distinguished as follows. In the male *violaceipennis*: metapleuron without prominent ridges, but with moderate-sized punctures and a reticulate or granulate surface, anterior surface smoother and occasionally even glossy; metanotal flange very large and rather deeply emarginate; cell R4 (third submarginal) usually not much

wider at bottom than at top. In the male *occidentalis*: punctures and ridges of metapleuron rather confused; metanotal flange quite small and not emarginate; cell R4 usually about twice as wide at bottom as at top. In the female *violaceipennis*: clypeus with many medium-sized punctures, surface reticulate and dull; other characters as in male. In *occidentalis*: punctures of clypeus quite large, surface reticulate but rather glossy.

Violaceipennis and *robusta* are best distinguished as follows. In the male *violaceipennis*: clypeal margin more rounded, first bend from the eye being rather slight; metapleuron without prominent ridges; metanotal flange very large and rather deeply emarginate. In the male *robusta*: clypeal margin not evenly rounded, first bend from the eye being rather sharp; metapleuron with distinct ridges, though they may be more or less broken; metanotal flange moderate in size, broadly and weakly emarginate. In the female *violaceipennis*: clypeus only slightly bulging, and at least in center with only moderate-sized and tiny punctures; upper edge of clypeus only lightly marked; other characters as in male. In the female *robusta*: clypeus moderately bulging, some punctures large; upper edge of clypeus very distinctly marked.

The characters given in the key are most useful in separating *violaceipennis* from *mickeli*. If confusing variations occur it will be necessary to check the complete descriptions. The most useful characters to use in separating *violaceipennis* from *clypeata* are given following the description of *clypeata*.

17. *Podalonia occidentalis* new species

(Figures 12, 24, 50)

1865. *Ammophila robusta* Cresson, Proc. Phila. Ent. Soc. 4: 461-462. Female (in part).
 1865. *Ammophila communis* Cresson, Proc. Phila. Ent. Soc. 4: 461-462. Male (in part).
 ?1902. *Psammophila communis* Melander & Brues, Biol. Bul. 3: 40-42. Male, female (in part).
 ?1903. *Ammophila grossa* Melander, Psyche 10: 156-164. Male, female (in part).
 1903. *Ammophila violaceipennis* Melander, Psyche 10: 156-164. Male, female (in part).
 1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30-37. Male, female (in part).

Male.—(See figure 12 for genitalia.) Length 14 mm. Head: clypeal margin extending downwards and slightly in-

wards for a short distance, then bending and extending almost transversely but slightly downwards for a shorter distance, there with a slight rounding, the margin then extending transversely to middle; clypeus moderately bulging above middle, slightly and broadly concave below middle; a moderate, not well-defined crescent-shaped depression in front of anterior ocellus; frontal suture distinct to ocellus, though much weaker in depression; surface of depression as well as of rest of frons granulate; frons with very large punctures, almost no tiny punctures; pilosity of head black. Thorax: collar moderately rounded; mesopleuron reticulate, with many large punctures, a few tiny punctures, a few short white sericeous hairs on lower part; metapleuron and propodeal side with many large punctures and confused ridges; metanotal flange small; pilosity of prothorax and mesonotum black, of rest of thorax white. Wings: cell R4 (3rd submarginal) about twice as wide at bottom as at top. Abdomen: first except at base, all of second, third except posterior dorsal part, and ventral half of fourth segments red, rest of abdomen black.

Female.—Length 16 mm. Clypeus bulging only very slightly in center, with many large punctures, surface reticulate; upper margin of clypeus well-marked in the form of a broad, shallow V. Thorax: pilosity entirely black. Abdomen: first, second, third, and ventral part of fourth segments red, rest black with an almost indiscernible bluish tint.

Holotype.—Male, Sargent, Colorado, June 24, 1929 (E. G. Anderson); it is located in the collection of the University of Minnesota at St. Paul, Minn.

Allotype.—Female, 22 mi. E. of Klamath Falls, Oregon, July 24, 1930 (H. A. Scullen); it is located in the collection of Oregon Agricultural College, Corvallis, Oregon.

Specimens examined: 46 ♂, 57 ♀; total specimens 103.

Paratypes.—

ARIZONA: ♂ [AES]; Mt. Lemmon, Santa Catalina Mts., ♀, July 27, 1917 [RD].

CALIFORNIA: Fallen Leaf Lake, El Dorado Co., ♀, July 1931 (O. H. Swezey) [CAS]; Hackamore, Modoc N. F., ♀, June 3, 1931 (K. A. Salman) [USNM]; Huntington Lake, 2 ♀, July 15, 1919 (F. E. Blaisdell) [CAS, UM]; Huntington Lake, 3 ♂, ♀, July 7, 12, 23, 1919 (E. P. Van Duzee) [CAS, UM]; Modoc N. F., ♀, June 26, 1931 (K. A. Salman) [USNM]; Mt. Fallao, ♂, July 1931 (O. H. Swezey) [CAS]; Sequoia Nat. Park, Giant Frst-Mrble Flk Kings R

trail, ♂, July 24, 1907 (J. C. Bradley) [CU]; Strawberry Valley, El Dorado Co., 2 ♀, July 7, Aug. 18, 1912 (E. C. Van Dyke) [CAS]. COLORADO: 5 ♂, 11 ♀ [USNM, UM, AES, HF, KU, INHS]; ♀ (T. D. A. Cockerell) [USNM]; 2 ♀, July (B. C. Kimball) [KSC, UM]; Creede, ♀, June 24, 1926 (E. G. Anderson) [UM]; Chimney Gulch, ♂ (N. Banks) [MCZ]; Elbert, ♂, June 9–11, 1922 [AMNH]; Halfway House, Pikes Peak, ♂, Sept. (Cockerell) [UC]; Halfway House, Pikes Peak, ♂, ♀, July 16–18, 20, 1902 (H. H. Newcomb) [MCZ]; 5 mi. NW. of McCoy, ♂, July 13, 1938 (R. Bauer) [UC]; 8 mi. S. of Mesa, scrub oak zone, ♀, July 12, 1938 (R. Bauer) [UC, UM]; Pikes Peak, ♂ ♀ in copulation, Aug. 19, 1904 [CS]; Pingree Park, ♀, Aug. 16, 1933 (H. G. Rodeck) [UC]; Roan Mts., above Ute trail, ♂, July (Cockerell) [UC]; Silver Plume, ♂, July 10, 1897 [AES]; Steamboat Springs, ♀, July 23, 1933 (H. J. Gibbons) [UC]; Ute Creek, 7 ♂, June 27, 28 (R. W. Dawson) [UN]; Ute Creek, 2 ♂, July 8 (H. S. Smith) [UN]; Virginia Dale, ♀, Aug. 2, 1935 (M. T. James) [CS]; Ward, ♂, June 25, 1922 [AMNH]; Westcliff, ♀, June 19, 1926 (E. G. Anderson) [UM].

IDAHO: Giveout, ♂, ♀, July 7, 1920 [AMNH].

MONTANA: Beaver Cr., ♀, Aug. 1913 (S. J. Hunter) [KU, UM].

NEW MEXICO: Clouderoft, ♀, June 28, 1932 (R. H. Beamer) [KU]; Jemez Mts., ♀, June 11 (Banks) [MCZ].

OREGON: Crater Lake Park, 2 ♂, 2 ♀, July 31, Aug. 8, 13, 25, 1930 (H. A. Scullen) [OAC, BM]; Crater Lake Park, nr headquarters, ♂, July 30, 1930 (F. Lyle Wynd) [OAC, UM]; 22 mi. W. of Crater Lake, Medford Road, ♀, Aug. 7, 1930 (H. A. Scullen) [OAC]; Hood R., ♀, July 17, 1931 (J. Nottingham) [KU]; Lake of the Woods, Klamath Co., ♀, July 18, 1930 (C. L. Godava) [OAC]; Lake of the Woods, Klamath Co., 3 ♂, July 21, 1930 (H. A. Scullen) [OAC, UM]; Lakeview, 2 ♀, July 24, 1930 (H. A. Scullen) [OAC, UM]; Mt. Jefferson, ♀, July 21, 1907 (J. C. Bridwell) [USNM]; Polina Lake, Deschutes Co., Canadian zone, ♂, Aug. 17, 1930 (H. A. Scullen) [HF]; Siskiyou Pass, Jackson Co., ♂, July 15, 1930 (H. A. Scullen) [OAC].

SOUTH DAKOTA: Custer, 2 ♂, 2 ♀ [UN].

UTAH: Beaver Canyon, ♀ [USNM]; Buckskin Valley, Iron Co., 2 ♂, ♀ [USNM, UM].

WASHINGTON: Pullman, ♂, June 20, 1901 [WSC].

WYOMING: Jackson, ♀, July 13–17, 1920 [AMNH].

ALBERTA: Delia, ♂, July 22, 1935 (E. H. Strickland) [UA]; Mayberries, ♀, Aug. 11, 1939 (E. H. Strickland) [UA]; Waterton, 2 ♀, July 10–13, 1923 (E. H. Strickland) [UA, UM].

NO LOCALITY: 6 ♀ [CS, USNM, AES].

Variations.—Sculpture of pleura, and especially of mesopleuron, rather variable; cell R4 (third submarginal) occasionally no wider at top than at bottom; in one specimen only two submarginal cells, the second transverse cubital missing. The shape of the clypeus varies slightly in both sexes.

For the best characters to use in separating *occidentalis* from *violaceipennis*, see the discussion under *violaceipennis*.

Typical specimens of this species are easily distinguished from typical specimens of *mickeli* and *robusta*. However, confusing variations occur in all these species, especially in the males. In the male *occidentalis*: ridges of metapleuron rather confused, generally running downwards and only slightly forwards; metanotal flange always small; thoracic pilosity generally white everywhere except on prothorax and mesonotum; cell R4 almost always twice as wide at bottom as at top; dark part of abdomen usually black. In the male *mickeli*: ridges of metapleuron not very distinct because of dense punctation; metanotal flange usually moderate in size; thoracic pilosity almost always entirely black, though sometimes it is partly white; cell R4 usually not much wider at bottom than at top; dark part of abdomen black. In the male *robusta*: ridges of metapleuron distinct, though more or less broken, generally slanting considerably forwards; metanotal flange varying from small to moderate; thoracic pilosity usually white in distribution range of *occidentalis* and *mickeli*; cell R4 not much wider at bottom than at top; dark part of abdomen usually distinctly bluish. If the specimens vary from the typical to any extent, it is absolutely necessary to rely on the male genitalia for the separation of these species.

The females of these three species are best distinguished by the shape and sculpture of the clypeus. In the female *occidentalis*: clypeus bulging only very slightly in center, surface reticulate. In the female *mickeli*: clypeus strongly bulging, peak of bulge at about center dorso-ventrally, very glossy between peak of bulge and margin, reticulate only along dorsal and lateral parts. In the female *robusta*: clypeus moderately bulging, peak of bulge below center dorso-ventrally, reticulate throughout.

18. *Podalonia sericea* new species

(Figures 15, 23, 64)

- ?1902. *Psammophila communis* Melander & Brues, Biol. Bul. 3: 40–42. Male, female (in part).
 ?1903. *Ammophila grossa* Melander, Psyche 10: 156–164. Male, female (in part).

- ?1903. *Ammophila violaceipennis* Melander, Psyche 10: 156–164. Male, female (in part).
 ?1908. *Psammophila grossa* H. S. Smith, Univ. Nebr. Studies 8: 330–331. Female (in part).
 1917. *Psammophila grossa* Mickel, Univ. Nebr. Studies 17: 87–88. Female (in part).
 1917. *Psammophila violaceipennis* Rohwer, Proc. U. S. Nat. Mus. 53: 241. Female.
 1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30–37. Male, female (in part).
 ?1928. *Podalonia violaceipennis* Williams, Proc. Hawaii Ent. Soc. 7: 163. Male, female.
 1933. *Podalonia violaceipennis* Hicks, Pan-Pacific Ent. 9: 49–52.

Male.—(See figure 15 for genitalia.) Length 16 mm. Head: clypeal margin extending downwards and somewhat inwards from the eyes for a short distance, bending and extending slightly more inwards for an equal distance, then rounding smoothly and running slightly upwards to center, forming a broad but rather shallow central emargination; clypeus with very heavy white pubescence, black pilosity not very heavy; frontal suture distinct to anterior ocellus; a deep well-marked frontal depression, with many tiny punctures laterally, surface granulate near frontal suture; frons with a good many large somewhat elongated punctures, and a very great many tiny punctures; pilosity of head not heavy, black except on cheeks where some hairs have white tips. Thorax: collar broadly rounded; mesopleuron with large punctures well-spaced, and with a great many tiny punctures from which conspicuous white sericeous hairs arise, giving a marked sericeous appearance to mesopleuron; mesopleuron glossy, not reticulated; metapleuron with many shallow large and small punctures, some low ridges, and a glossy, somewhat wavy surface; propodeal side with rather weak ridges, front part with large punctures making the ridges less obvious; a weak sericeous patch beside petiole attachment; metanotal flange quite large, the edge tending to roll downwards slightly; prothorax and mesonotum with black pilosity, rest of thorax with mostly white pilosity, though with a few hairs black and some black at bases and white at tips. Petiole: slender and nearly straight. Abdomen: first segment black at base, rest of first, all of second and third, and half of fourth segments red, rest of abdomen dark blue.

Female.—Length 17 mm. Head: clypeus strongly bulging, surface reticulate, large punctures variable in size; upper edge of clypeus distinct, curved. Thorax: surface of meso- and metapleura glossy, not reticulate, with many tiny punctures between large ones; a thin spot of brownish sericeous hairs beside petiole attachment, an area on posterior part of metapleuron, a thin band in front of metapleural-propodeal suture, and an area in front of meso-metapleural suture extending somewhat over mesopleuron; pilosity of thorax entirely black. Petiole: only slightly longer than hind coxa, but rather slender. Abdomen: first, second, third, and lateral and ventral parts of fourth segments red, rest of abdomen dark blue.

Holotype.—Male, Niles, California, July 11, 1936 (A. E. Pritchard), located in the collection of the University of Minnesota at St. Paul, Minn.

Allotype.—Female, Laramie, Wyoming (28 mi. W.) 7700 ft. elev., Aug. 6, 1934 (H. A. Scullen), deposited in the collection of Oregon Agricultural College, Corvallis, Oregon.

Specimens examined: 82 ♂, 94 ♀; total specimens 176.

Paratypes.—

ARIZONA: ♂ [USNM]; Phoenix, ♀ [HF]; Prescott, ♀, July 10, 1910 (J. A. Kutsche) [CAS].

CALIFORNIA: Benicia, ♀, Aug. 14, 1910 (J. C. Bridwell) [USNM]; Burbank, ♀, Nov. 15, 1935 (C. H. Hicks) [CH]; Calexico, ♂, ♀, Aug. [MCZ, JB]; Devils Post Pile, ♂, Aug. 28, 1937 (E. G. Anderson) [UM]; Fresno Co., ♂ [USNM]; Giant Frst., Tulage Co., ♂, July 18, 1933 (C. L. Fox) [CAS]; Lond Canon, San Gabriel Mts., ♂, July 13, 1910 (F. Grinnell, Jr.) [USNM]; Los Angeles, 5 ♀, Sept. 16, 17, Oct. 8, 22, Nov. 23, 1927 (C. H. Hicks) [CH, UM]; Meadow Valley, Plumas Co., ♂, ♀, July 1, 4, 1924 (E. C. Van Dyke) [CAS, UM]; Milford, ♀, Aug. 29, 1933 (K. A. Salman) [USNM]; Mill Crk. Cyn., San Bernardino Co., ♀, Sept. 24, 1923 (E. P. Van Duzee) [CAS]; Mt. Shasta, ♀, June 29, 1935 (E. J. Beamer) [KU]; Needles, 2 ♀, Dec. 3, 1921 (J. A. Kutsche) [CAS, UM]; Pasadena, ♀, June 21, 1891 (R. W. Doane) [WSC]; Sacramento, 2 ♂, ♀, Sept. 27, 28, Oct. 6, 1916 (L. Bruner) [UN]; Santa Ana R., San Bernardino Mts., 2 ♂, June 14, Aug. 1, 1907 (J. Grinnell) [USNM, UM].

COLORADO: 3 ♀ [USNM, UN, CS]; ♀, May 27 [KSC]; ♂, ♀ [AES]; Boulder, ♂, June 18, 1933 (H. I. Gibbons) [UC]; Clear Creek, ♀ (Osler) [MCZ]; Colorado Springs, ♂, May 25, 1934 [CS]; Craig, ♂, June 30, 1931 (J. Nottingham) [KU]; Creede, ♀, Aug. 1914 (S. J. Hunter) [KU]; Delta, 5 ♂, June 26, July 3, 1938 (R. Bauer) (U.

Lanham) [UC, UM]; Denver, ♀, Oct. 5, 1901 [CS]; Ft. Collins, ♀, Sept. 12, 1934 [CS]; Massadona, ♂, 2 ♀, July 1, 1931 (R. H. Beamer) [KU, UM]; Poudre Canyon, W. of Ft. Collins, ♂, Aug. 8, 1934 (N. Dondelinger) [UC]; Powderhorn, ♂, June 23, 1926 (E. G. Anderson) [UM]; Pueblo, ♀, Aug. 9, 1920 [AMNH]; RM Boys Camp, RMNP, ♂, July 11, 1933 (Helen Rodeck) [UC]; Russell, ♂, July 12 (H. S. Smith) [UN]; Salida, ♀, Oct. 1898 [CS]; Ute Creek, 3 ♂, ♀, July 3, 17, Aug. 11 (L. Bruner) [UN]; Ute Creek, 7 ♂, ♀, June 28, July 1, 8, 30, Aug. 11 (R. W. Dawson) [UN]; Westeliff, ♂, June 19, 1926 (E. G. Anderson) [BM]; Westeliff, 2 ♀ (Ashmead) [USNM, UM]; White Rocks, Valmont, ♂, May 30, 1934 (M. & H. James) [CS].

IDAHO: Warren, Idaho Co., ♀ [MCZ].

ILLINOIS: Savanna, ♂, July 29, 1892 (Forbes & Shiga) [INHS].

MICHIGAN: South Haven, ♂, July 19, 1925 (E. G. Anderson) [UM]; Whitefish Pt., ♀, July 4, 1918 (A. W. Andrews) [USNM].

MONTANA: 5 ♀ [AES, UM]; Weeksville, ♂, Aug. 2, 1882 [MCZ].

NEBRASKA: Glen, Sioux Co., ♀, Aug. 12, 1906 (P. R. Jones) [UN]; Halsey, ♀, Aug. 29, 1912 (J. T. Zimmer) [UN]; Mitchell, ♀, Sept. 12, 1916 (R. W. Dawson) [UN]; Mitchell, ♀, Aug. 31, 1915 (E. M. Partridge) [UN]; Monroe Canon, Sioux Co., ♀, Aug. 13, 1912 (R. W. Dawson) [UN].

NEVADA: 3 ♂, ♀ [AES, UM]; Fallon, 3 ♂, May 25, June 10, 14, 1930 (E. L. Bell) [AMNH]; Reno, ♂, Sept. 1889 (F. H. Hillman) [USNM].

NORTH DAKOTA: Cannon Ball, ♂, 2 ♀, Aug. 20, 1922 (O. A. Stevens) [OS].

OREGON: Antelope Mt., Harney Co., ♂, Aug. 9, 1931 (D. K. Frewing) [OAC]; Arlington, ♂, July 15, 1931 (J. Nottingham) [KU]; Biggs, ♂, July 16, 1931 (J. Nottingham) [KU]; Boardman, 4 ♂, July 15, 1931 (J. Nottingham) [KU]; Chemult, ♀, Aug. 10, 1935 (H. A. Scullen) [OAC]; Cornucopia, Lookout Trail, ♀, July 24, 1936 (H. A. Scullen) [OAC]; Corvallis, ♀, Sept. 25, 1905 (Rickard) [OAC]; Corvallis, ♀, Aug. 23, 1932 (H. A. Scullen) [OAC, UM]; Crater Lake Pk., Je. Hwy. #97 & E. ent., ♂, Aug. 10, 1935 (Geo. Ferguson) [OAC, UM]; Dixie, 2 ♂, July 8, 1931 (J. Nottingham) [KU]; Island City, ♂, July 3, 1906 (Reynolds) [OAC]; Kooney Camp Springs, Sheep Mt., Grant Co., ♂, July 19, 1936 (H. A. Scullen) [OAC]; Prineville, ♂, Aug. 12, 1929 (H. A. Scullen) [OAC, UM]; Suttle Lake, ♂, Aug. 7, 1935 (H. A. Scullen) [OAC]; Umatilla, ♂, July 14, 1931 (J. Nottingham) [KU, UM].

SOUTH DAKOTA: Buffalo Vy., Stanley Co., ♀, Oct. 1-7, 1913 (W. H.

Over) [USNM]; Hot Springs, ♀, July 5, 1924 (H. C. Severin) [SD]; Hot Springs, ♀, Aug. 1, 1932 [SD]; Milesville, ♀, June 23, 1931 (H. C. Severin) [SD]; Pierre, 2 ♀ [SD, MCZ]; Pierre, ♂, ♀ [AES, UM]; Spearfish, ♂, July 28, 1924 (Severin) [MCZ].

UTAH: Cornish, ♂, Sept. 15, 1926 (G. F. Knowlton) [UM]; Jensen, ♂, July 27, 1930 (G. Fairchild) [RD]; Emery Co., 3 ♀, Sept. 6, 1921 (Grace O. Wiley) [UM]; Ft. Duchesne, ♂, Aug. 4, 1932 (F. K. Stoffers) [UAES]; Provo, ♂, July 29, Aug. 1, 1920 [AMNH]; Sand Dunes, ♂, July 13, 1923 (J. A. Harris, Jr.) [UM]; Trout Creek, ♂, July 23, 1933 (H. B. Stafford) [UAES].

WASHINGTON: Buena, ♀, July 1, 1923 (A. Spuler) [WSC]; N. Yakima, ♂, 2 ♀, July 15, Aug. 14, Sept. 26, 1903 (Eldred Jenne) [WSC]; Republic, ♂, Aug. 6, 1931 (L. D. Anderson) [KU]; Toppenish, ♀, July 24, 1924 (Spuler) [WSC]; Wawawai, ♀, June 9, 1908 (W. M. Mann) [MCZ]; Wawawai, ♀ (W. M. Mann) [CAS]; Wawawai, ♂, July 1898 [WSC]; Yakima River, ♂, July 4-5, 1882 (Nelson) [MCZ]; Yakima River, ♀ [MCZ].

WYOMING: Rawlins, 2 ♂, June 26, 1920 [AMNH].

ALBERTA: Edgerton, 4 ♀, Aug. 31, 1939 (E. H. Strickland) [UA, UM]; Manyberries, ♀, Aug. 11, 1939 (E. H. Strickland) [UA]; Medicine Hat, ♀, Aug. 9, 1939 (E. H. Strickland) [UA].

BRITISH COLUMBIA: Armstrong, ♀, July 4, 1931 (A. N. Gartrell) [CNM]; Copper Mtn., ♀, Aug. 7, 1928 (W. Stace Smith) [CNM]; Lytton, ♀, Aug. 2, 1931 (L. D. Anderson) [KU]; Merritt, 8 ♀, Aug. 3, 1931 (J. Nottingham) (R. H. Beamer) [KU, UM]; Okanagan Falls, ♀, July 24, 1917 (Sladen) [CNM]; Princeton, ♂, July 10, 1909 [MCZ]; Shingle Cr. Road, Keremeos, ♀, July 30, 1933 (A. N. Gartrell) [CNM].

MANITOBA: Aweme, ♂, ♀, Sept. 11, 1925 (R. D. Bird) [CNM].

SASKATCHEWAN: Radisson, ♀, July 30, 1907 (J. Fletcher) [CNM].

UNLABELED: 2 ♀ [CS, USNM]; ♂ (Snow) [KU]; ♂, June 8, 1901 [AES].

Variations.—Metapleuron sometimes wavy and with weak ridges over the entire surface; propodeal side sometimes definitely ridged everywhere. Male: length 10-16 mm.; rarely clypeal margin extending downwards and inwards a short distance, then bending sharply to run transversely to center without further bending or any central emargination; rarely frontal depression shallow and not well-marked; rarely clypeus with a few white pilose hairs; pilosity of cheeks rarely entirely white; all pilose hairs of thorax except on prothorax may be white; sometimes propodeum with a definite sericeous patch on each side of petiole attachment, and meso- and meta-

pleura occasionally rather sericeous; only very rarely that mesopleuron is not markedly sericeous, these cases apparently due mainly to rubbing; amount of red on abdomen occasionally reduced to second segment only; sometimes abdomen red and bright blue. Female: length 14–18 mm.; rarely mesopleuron without tiny punctures; fine brownish sericeous hairs sometimes conspicuous over entire meso- and metapleura and propodeal side; pilosity of posterior part of mesopleuron, and all of metapleuron and propodeum, white in several specimens; in several specimens abdomen entirely red.

This species is most closely related to *robusta* and *mickeli*. In the male *sericea*: frontal depression deep and well-marked, almost circular except where ocellus projects into it; mesopleuron with large punctures well-spaced, very many shallow tiny punctures from which white sericeous hairs arise, these hairs abundant up to rectangle; surface of mesopleuron glossy; metapleuron rather crinkly, ridges poorly marked and tiny punctures shallow, surface glossy and with white sericeous hairs; pilosity of thorax mostly white. In the male *robusta*: frontal depression moderately deep, elongated anteriorly, the limits not well-defined; usually only a few, and sometimes no sericeous hairs on meso- and metapleura; large punctures of mesopleuron numerous, surface of plate distinctly reticulate, therefore not as glossy as in *sericea*; metapleuron more or less distinctly ridged, surface reticulate; pilosity of thorax mostly white. In the female *sericea*: mesopleuron with a great many tiny punctures and a glossy surface, short brownish sericeous hairs more or less conspicuous. In *robusta* and also *mickeli*: mesopleuron with very few tiny punctures, surface reticulate and not highly glossy; brownish sericeous hairs occasionally present but not usually as conspicuous as in *sericea*. The notes under *mickeli* give the best characters for separating *mickeli* from *robusta*, and those notes on *mickeli* can be compared with these notes on *sericea* for separating *mickeli* from *sericea*.

19. *Podalonia robusta* (Cresson)

(Figures 18, 19, 25, 60)

1865. *Ammophila robusta* Cresson, Proc. Phila. Ent. Soc. 4: 461–462. Female (in part).
 1865. *Ammophila communis* Cresson, Proc. Phila. Ent. Soc. 4: 462. Male (in part).
 1882. *Ammophila communis* Provancher, Natural. Canad. 13: 13. Male, female (in part).

1883. *Ammophila communis* Provancher, Faun. Entom. Canad. Hym. 2: 614. Male, female (in part).
- ?1902. *Psammophila communis* Melander & Brues, Biol. Bul. 3: 40-42. Male, female (in part).
- ?1903. *Ammophila grossa* Melander, Psyche 10: 156-164. Male, female (in part).
1903. *Ammophila violaceipennis* Melander, Psyche 10: 156-164. Male, female (in part).
1908. *Psammophila grossa* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Female (in part).
1908. *Psammophila violaceipennis* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Male (in part).
1917. *Psammophila grossa* Mickel, Univ. Nebr. Studies 17: 87-88. Female (in part).
1917. *Psammophila violaceipennis* Mickel, Univ. Nebr. Studies 17: 87-88. Male (in part).
1917. *Psammophila violaceipennis* Rohwer, Proc. U. S. Nat. Mus. 53: 241. Female.
1917. *Psammophila violaceipennis* Rohwer, Conn. Geol. & Nat. Hist. Surv. 22: 681. Male, female (in part).
- ?1925. *Psammophila grossa* Carter, Canad. Ent. 57: 132. Male, female.
1927. *Podalonia violaceipennis* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 30-37.
- ?1936. *Podalonia violaceipennis* Krombein, Ent. News 47: 93-99. Female.
1936. *Podalonia violaceipennis* Balduf, Canad. Ent. 68: 137-138. Female (in part).

Male.—(See figures 18 and 19 for genitalia.) Length 15 mm. Head: clypeal margin extending downwards and somewhat inwards for a distance, then bending and extending almost transversely but slightly downwards for an equal distance, then curving smoothly to run slightly upwards to center, forming a slight central emargination; frontal suture distinct to anterior ocellus; a rather long shallow frontal depression, its surface granulate; surface of frons with large rounded punctures and many tiny punctures, the latter especially noticeable along frontal suture and extending onto depression; pilosity of head moderately heavy, black. Thorax: collar broadly rounded; mesopleuron with very large round punctures, tiny punctures sparse on upper part but increasing in numbers below; surface of mesopleuron with very fine reticulation which cuts down

gloss; propodeal side and metapleuron with broken ridges and large punctures, surface reticulate and with very fine ridges; metanotal flange moderate in size; some pilose hairs of thorax all black, especially anteriorly, some all white, especially laterally, and some black basally and with white tips. Petiole: slender. Abdomen: first segment piceous, reddish laterally, second segment entirely red, third red at base ventrally, rest of abdomen dark blue.

Female.—Length 16 mm. Head: clypeus rather bulging, peak of bulge below middle of clypeus dorso-ventrally; clypeus with many large punctures and a reticulate surface throughout; upper edge of clypeus slightly curved; frontal depression not as evident as in male. Thorax: propodeal side and metapleuron more strongly ridged than in male; mesopleuron more conspicuously reticulate than in male; mesopleuron with almost no tiny punctures; pilosity of thorax entirely black. Petiole: slender, distinctly longer than hind coxa, proportion being 1.25 for petiole to 1 for coxa. Abdomen: first, second, and anterior half of third segments entirely red, rest of abdomen dark blue.

Redescribed from a male and a female, both having been compared with the holotype; male, Viking, Minnesota, Aug. 10, 1935 (D. G. Denning); female, Todd Co., Minnesota, Aug. 14, 1936 (D. Murray); both are located in the collection of the University of Minnesota, St. Paul, Minn.

Holotype.—Female, Colorado; located in the collection of the American Entomological Society, Philadelphia, Pa.

Allotype.—The male described herein is designated as the allotype.

Specimens examined: 296 ♂, 310 ♀; total specimens 606.

Robusta has been collected in the following states, provinces and countries: MAINE, NEW HAMPSHIRE (June 10–Sept. 18), VERMONT, MASSACHUSETTS, CONNECTICUT, NEW JERSEY, PENNSYLVANIA, MICHIGAN, WISCONSIN, ILLINOIS, MINNESOTA (June 10–Sept. 19), NORTH DAKOTA, SOUTH DAKOTA, NEBRASKA, KANSAS, TEXAS, MONTANA, WYOMING, COLORADO (May 18–Oct. 1), NEW MEXICO, UTAH, ARIZONA, IDAHO, WASHINGTON (May 25–Sept. 26), OREGON, CALIFORNIA, NOVA SCOTIA, NEW BRUNSWICK, QUEBEC, ONTARIO, MANITOBA, SASKATCHEWAN, ALBERTA, BRITISH COLUMBIA, MEXICO, COSTA RICA.

Variations.—Male: length 12–16 mm.; frontal suture occasionally obsolete in upper part of frontal depression; frontal depression sometimes scarcely evident; collar sometimes only moderately rounded; mesopleuron sometimes with many tiny punctures over

entire plate, and short ridges in front of the large punctures; white sericeous hairs sometimes arise from most of the tiny punctures of mesopleuron, these hairs not as long or as abundant as in *sericea*; rarely surface of anterior part of metapleuron glossy; rarely propodeal side and metapleuron with large round punctures and no ridges whatever; ridges of metapleuron and propodeal side sometimes strong and run across both segments; sometimes metanotal flange quite small; rarely dark part of abdomen black rather than dark blue; in western specimens dark part of abdomen usually more brilliantly blue than in eastern specimens; in one specimen abdomen entirely blue except for second segment, this being entirely red ventrally and with a narrow red band dorsally; pilosity of thorax varying from all white except on prothorax and mesonotum, where some hairs have black bases, to all black. Female: length 13–19 mm.; large punctures of frons occasionally irregular in size and shape, resembling those in *sericea*; occasionally ridges of metapleuron and propodeal side run strongly forwards; first four abdominal segments occasionally entirely red; pilosity of petiole, propodeum, meta- and mesopleura sometimes partly white, though the black hairs become more numerous anteriorly.

For distinctions between *robusta* and its most closely related species, see the notes following the descriptions of *sericea*, *violaceipennis*, *mickeli*, *occidentalis* and *parallela*.

20. *Podalonia parallela* new species

(Figure 61, male clypeus as in figure 25, genitalia as in figures 18 and 19)

1927. *Podalonia argentifrons* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, pp. 26–30. Male, female (in part).

Male.—(For genitalia see figures 18 and 19.) Length 13 mm. Head: clypeal margin extending downwards and somewhat inwards for a distance, then bending and extending almost transversely but slightly downwards for an equal distance, then curving smoothly to run slightly upwards to center, forming a slight central emargination; frontal suture distinct to anterior ocellus; frontal depression moderate, with a great many tiny punctures, giving a granulated appearance; rest of frons with a few well-spaced large punctures and a great many tiny punctures, surface rather glossy; pilosity of head black. Thorax: collar moderately rounded; mesopleuron with a moderate number of large round punctures, and a large number of tiny punctures from which short white sericeous hairs arise,

thus when held at proper angle entire plate except rectangle appearing thinly sericeous; these tiny punctures vary in size to the very minute punctures which produce the surface reticulation; large punctures of metapleuron tending to elongate posteriorly; surface of metapleuron ridged so as to give a slightly crinkly appearance, sparsely covered with sericeous hairs which become more numerous along metapleural-propodeal suture; propodeal side with large punctures arranged in rows which are separated by ridges, appearance of plate similar to metapleuron; propodeal side posteriorly and propodeal end sparsely sericeous; metanotal flange small; pilosity of thorax entirely black. Abdomen: steel blue.

Female.—Length 15 mm. Head: clypeus rather bulging, peak of bulge below center of clypeus dorso-ventrally; clypeus with scattered large and tiny punctures, surface reticulate; frons with fewer tiny punctures than in male, surface reticulate. Thorax: mesopleuron with a moderate number of large punctures, almost no tiny punctures, surface distinctly reticulate; metapleuron and propodeal side with distinct ridges running forwards and downwards; no sericeous hairs on pleura as in male.

Holotype.—Male, Big Bear Lake, San Bernardino Mts., California, July 16, 1934 (E. G. Anderson), deposited in the collection of the University of Minnesota, St. Paul, Minn.

Allotype.—Female, Auburn, California, Oct. 20, 1918 (L. Bruner), located in the collection of the University of Nebraska, Lincoln, Nebr.

Specimens examined: 19 ♂, 11 ♀; total specimens 30.

Paratypes.—

CALIFORNIA: Auburn, 5 ♂, 4 ♀, Sept. 20, 1916, Aug. 24, 1918 (L. Bruner) [UN]; Big Bear Lake, San Bernardino Mts., 2 ♂, July 16, 1934 (E. G. Anderson) [UM]; Bradley, ♂, April 27, 1919 (E. P. Van Duzee) [CAS]; Burbank, ♂, Nov. 15, 1935 (C. H. Hicks) [CH]; Mts. nr. Claremont, ♂ (Baker) [CU]; Crystal Lake, San Gabriel Mt., ♂, July 7, 1934 (E. G. Anderson) [UM]; Cr. Sp., ♂, Sept. 3, 1871 (Beckrus) [MCZ]; Mill Cr. Cn., San Bernardino Co., 2 ♂, Sept. 24, 1923 (E. P. Van Duzee) [CAS, UM]; Pacific Grove, Monterey Co., ♀, Sept. 20 (F. E. Blaisdell) [CAS]; Pasadena, ♂, Aug. 13 (Hayes) [OAC]; Pyramiol Pk., El Dorado Co., ♂, Aug. 8, 1912 (E. C. Van Dyke) [CAS]; Redlands, ♀, July 3, 1918 (H. A. Scullen) [OAC]; San Francisco, ♀, Sept. 8, 1920 (E. P. Van Duzee) [CAS]; San Jacinto Mts., ♂, July 21, 1929 (L. D. Anderson) [KU];

San Jacinto Mts., Tahquitz Valley, ♀, July 17, 1912 (J. C. Bridwell) [USNM]; Santa Monica, ♂, June 1892 (C. E. Hutchinson) [USNM]; So. California, ♀, Summer 1934 (A. C. Browne) [KS]; Stone Cn., Monterey Co., ♀, April 21, 1919 (E. P. Van Duzee) [UM].

Variations.—Rarely frontal suture obsolescent. Male: clypeal margin somewhat variable; sericeous hairs on mesopleuron more conspicuous in some specimens than in others; in one specimen extreme anterior part of metapleuron with one or two large punctures and a highly glossy surface; ridges of metapleuron and propodeal side sometimes rather strong and regular; a tendency for bluish color to show on places other than on abdomen: petiole, costa of wings, proximal segments of legs, and even some surface of head and thorax may show a more or less distinct bluish color.

Superficially *parallela* appears to be most closely related to the *argentifrons* group because of the entirely blue abdomen. Actually, however, it is extremely closely related to *robusta*, the only reliable separation being based on the color of the abdomen. The genitalia are apparently identical. The metanotal flange is smaller in *parallela* than in the typical *robusta*, the pilosity in the male is entirely black, while in *robusta* the pilosity is usually white on at least part of the thorax in the western part of the United States.

The best characters for separating the males and females of *parallela* from *mexicana* are given in the key to the species.

One may well doubt whether this should be considered as a distinct species or as a subspecies of *robusta*. *Parallela* does not offer the variation found in *robusta*, but appears to be quite uniform in many characters, as in the punctuation of the head and thorax, sericeous hairs on pleura, color of thoracic pilosity, size and shape of the metanotal flange, and in the size of the insect as a whole. Considering the present evidence, it is believed best to give *parallela* the rank of a distinct species.

21. *Podalonia caerulea* new species

(Figures 8, 44, 58)

Male.—(For genitalia see figure 8.) Length 13 mm. Head: clypeal margin extending downwards and slightly inwards for a considerable distance, then bending inwards slightly and extending a short distance, then bending inwards to extend transversely to center, a faint indentation in center; clypeus almost flat; frontal suture distinct to anterior ocellus; frontal depression shallow and not well-defined, surface granulate and without punctures; frons with a moderate number of large punctures,

with many tiny punctures, surface faintly reticulate and rather glossy; pilosity of head black. Thorax: collar narrowly rounded; mesopleuron with many large round punctures which become smaller and more separated posteriorly; surface of mesopleuron faintly reticulate and inclined to be crinkly; metapleuron and propodeal side with large punctures so close together as to give a coarsely reticulated appearance to these plates; metanotal flange very small; pilosity of thorax black. Head and thorax metallic blue, abdomen purplish blue.

Female.—Unknown.

Holotype.—Siskiyou Co., California, June 2, 1911 (F. W. Nune-macher), located in the collection of the United States National Museum at Washington, D. C.

Distinct from all known *Podalonia* by the metallic blue head and thorax, and also by the male genitalia. On the basis of color and certain other characters, *caerulea* appears to be most closely related to *parallela*. These resemblances may be entirely superficial, however.

This is the rarest species of the genus *Podalonia* in North America, being known only from the holotype, and an effort should be made by collectors to obtain more specimens. It is probable that this species is very limited in distribution.

22. *Podalonia mickeli* new species

(Figures 17, 21, 65)

1865. *Ammophila robusta* Cresson, Proc. Phila. Ent. Soc. 4: 461-462. Male, female (in part).
- ?1891. *Ammophila robusta* Aldrich, Canad. Ent. 23: 136-137. Female.
- ?1902. *Psammophila communis* Melander & Brues, Biol. Bul. 3: 40-42. Male, female (in part).
- ?1903. *Ammophila grossa* Melander, Psyche 10: 156-164. Female (in part).
- ?1903. *Ammophila violaceipennis* Melander, Psyche 10: 156-164. Male, female (in part).
1908. *Psammophila grossa* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Female (in part).
1908. *Psammophila violaceipennis* H. S. Smith, Univ. Nebr. Studies 8: 330-331. Male (in part).
1917. *Psammophila grossa* Mickel, Univ. Nebr. Studies 17: 87-88. Female (in part).
1917. *Psammophila violaceipennis* Mickel, Univ. Nebr. Studies 17: 87-88. Male (in part).

?1925. *Psammophila grossa* Carter, *Canad. Ent.* 57: 132. Male, female.

1927. *Podalonia violaceipennis* Fernald, *Proc. U. S. Nat. Mus.* 71, Art. 9, pp. 30-37. Male, female (in part).

Male.—(See figure 17 for genitalia.) Length 16 mm. Head: clypeal margin extending downwards and somewhat inwards for a short distance, then bending and extending slightly more inwards for an equal distance, then rounding smoothly and running slightly upwards to center, forming a rather broad and shallow central emargination; frontal suture distinct to anterior ocellus; frontal depression almost round except where the ocellus cuts into it; frontal depression reticulate, frons and vertex with many large punctures, and many tiny punctures except along frontal suture; pilosity of head very dense, black. Thorax: collar narrowly rounded at top; mesopleuron with many round large punctures, surface weakly reticulate with no ridges except ventrally; metapleuron with very many large elongated punctures, surface between punctures with weak reticulations; propodeal side with many large punctures which have short ridges in front of and behind them and tending to form rows; metanotal flange moderately large, slightly emarginate; pilosity of thorax entirely black. Petiole: black, heavier in middle below, giving the ventral side a curved appearance; about as long as or slightly longer than hind coxa and trochanter together. Abdomen: first, second, and anterior half of third segments red, rest of abdomen black.

Female.—16 mm. Head: clypeus strongly bulging, with many large punctures and a reticulate surface except between peak of bulge and anterior margin, this latter region highly glossy and with a few moderate-sized punctures; peak of bulge almost in middle of clypeus dorso-ventrally; upper edge of clypeus broadly V-shaped; frontal suture quite distinct, surface on each side finely reticulate; frontal depression shallow and more elongate than in male. Thorax: surface of mesopleuron distinctly reticulate, with large but almost no tiny punctures; metapleuron except anteriorly, and propodeal side with ridges between punctures. Petiole: stout, only very slightly longer than hind coxa, proportion being 1.1 for petiole to 1 for coxa; slightly bulging in middle below. Abdomen: first, second, and all but dorsal tip of third segments red, rest of abdomen black.

Holotype.—Male, Euclid, Polk Co., Minnesota, July 13, 1936 (D. G. Denning); it is deposited in the collection of the University of Minnesota, St. Paul, Minn.

Allotype.—Female, Itasca Park, Minnesota, July 1, 1936; it is deposited in the collection of the University of Minnesota.

Specimens examined: 69 ♂, 110 ♀; total specimens 179.

Paratypes.—

ARIZONA: Flagstaff, ♀, July 17, 1930 (T. F. Winburn, R. H. Painter) [KSC].

CALIFORNIA: Lake Tahoe, ♀, Aug. 22, 1916 (L. Bruner) [UN].

COLORADO: 4 ♂, ♀ [AES, USNM, UM]; Bennet Crk., ♂, Sept. 7, 1933 [CS]; Creede, 6 ♀, Aug. 1914 (S. J. Hunter) [KU, UM]; Cumbres, ♂, July 22–23, 1902 (H. H. Newcomb) [MCZ]; Lump Gulch nr. Gilpin, ♀, Aug. 8, 1934 (H. G. Rodeck) [UC]; Monte Vista, ♀, June 16, 1919 [AMNH]; Moraine Park, RMNP, June 29, 1933 (Helen Rodeck) [UC]; Pikes Peak, ♀, June 22, 1932 (M. J. Oosthuizen) [UM]; Pingree Park, Larimer Co., Aug. 17–22, 1925 (F. C. Hottes) [UM]; Pingree Park, Larimer Co., ♀, Aug. 15, 1934 (C. H. Hicks) [CH]; Pingree Park, Larimer Co., ♂, July 7, 1932 (S. C. McCampbell) [CS]; Pingree Park, Larimer Co., 2 ♀, Aug. 17, 1932, Aug. 14–19, 1933 (M. & H. James) [CS, UM]; Summit Vega Pass, ♀, July 28, 1877 [USNM]; Ute Creek, 2 ♀, July 3, 31 (L. Bruner) [UN]; Ute Creek, ♂, ♀, July 6, Aug. 15 (R. W. Dawson) [UN].

GEORGIA: ♀ (A. L. Melander) [WSC]. (Considerable doubt must be placed on this record.)

IOWA: Ames, 2 ♂ (E. D. Ball) [AES, UM]; Dickinson Co., ♀, June 23, 1934 (H. E. Jaques) [IWC]; Sioux City, ♀ (C. N. Ainslie) [UM].

KANSAS: ♀ [AES]; Cimmaron, ♂, June 6, 1926 (E. G. Anderson) [UM]; Riley Co., 2 ♀, Oct. (Marlatt) [USNM, UM]; Trego Co., ♀, Nov. 14 [KSC].

MINNESOTA: Ashby, ♀, Aug. 28, 1911 [UM]; Big Stone Co., ♀, June 22, 1910 [UM]; Big Stone Co., Artichoke twnp., ♀, Sept. 5, 1937 (W. Stehr) [WS]; Crookston, 2 ♀, Sept. 5, 1936, June 18, 1937 (D. G. Denning) [UM]; Detroit, ♀, Aug. 26, 1924 (O. A. Stevens) [UM]; Detroit, ♂, June 17, 1911 (C. H. Waldron) [OS]; Fergus Falls, ♂, ♀, Aug. 11, 25, 1911 (Stoner) [UM]; Fergus Falls, 2 ♀, July 17, 1911 (Zetek) [UM]; Ft. Snelling, ♀, July 3, 1923 (A. T. Hertig) [UM]; Itasca Park, ♀, July 6, 1936 (A. C. Hodson) [UM]; Itasca Park, ♂, 7 ♀, June 18, 19, 20, 21, 25, 28, July 11, 14, 1936 [UM, BM]; Kittson, 2 ♀, Aug. 20, 28, 1936 (D. G. Denning) [UM]; Lake Benton, ♂, Sept. 12, 1935 (C. E. Mickel) [UM]; Lancaster, ♂, 2 ♀, Aug. 26, 1935, Aug. 7, 1936 (D. G. Denning) [UM]; Laporte, ♀, Aug. 6, 1930 (D. G. Denning) [UM]; Marshall Co., ♀, July 28, 1911 [UM]; Norman Co., ♀, Sept. 7, 1937 (D. G. Denning) [UM]; Polk Co., ♂,

2 ♀, July 18, 29, 1936, July 5, 1937 (D. G. Denning) [UM]; St. Anthony Park, ♀, [UM]; Sedan, ♀, Sept. 19, 1929 (D. G. Denning) [UM]; Sherburne Co., sandbank, ♀, Sept. 25, 1924 (W. Carter) [UM]; Strandquist, ♂, Aug. 9, 1935 (O. Pearson) [UM]; Wall Lake, 2 ♀, Aug. 30, 1911, 1913 [UM].

MONTANA: ♂, 2 ♀ [AES, USNM]; Big Fork, ♂, June 22, 1904 [MSC, UM]; Moccasin, ♀, Aug. 1-15, 1915 (LeR. Moomaw) [USNM]; Rapelje, ♂, Sept. 11, 1928 [MSC].

NEBRASKA: Crawford, ♂, June 10, 1910 (L. Bruner) [UN]; Harvard, ♀, June 8, 1932 (Lyle Selko) [UN]; Holt Co., ♀ [UN]; Lincoln, ♂, 2 ♀, June, July [UN]; Mitchell, ♀, Sept. 12, 1916 (R. W. Dawson) [UN]; So. Sioux City, ♀, July 3, 1912 (L. T. Williams) [UN]; West Point, ♀, Sept. 20 [UN].

NEW MEXICO: Alto, ♂, June 24, 1932 (K. C. Doering) [KU].

NORTH DAKOTA: Beach, 7 ♂, 3 ♀, Aug. 17, Sept. 3, 5, 1921, Sept. 16, 1922, May 20, 1926 (C. N. Ainslie) [UM, BM]; Binford, ♂ ♀ in copulation, Aug. 25, 1919 (O. A. Stevens) [UM]; Bottineau, ♀, Aug. 25, 1919 (C. N. Ainslie) [UM]; Fargo, 2 ♂, 2 ♀, July 31, Aug. 10, 1910, Sept. 15, 1911 [OS, UM]; Gascoyne, 2 ♂, June 16, 1918 (O. A. Stevens) [OS]; Monango, ♀, July 3, 1913 (O. A. Stevens) [OS]; Sheldon, ♀, June 12, 1934 (O. A. Stevens) [OS]; Turtle Mts., ♂, July 8, 1917 (O. A. Stevens) [OS].

OREGON: Camp Umatilla, ♂, June 26, 1882 [MCZ]; Drake Peak, Lake Co., ♀, July 26, 1930 (H. A. Scullen) [OAC].

SOUTH DAKOTA: Brookings, ♂, 4 ♀ [MCZ]; Brookings, 3 ♂, ♀, May 26, 1891 [MCZ]; Buffalo, ♀, Sept. 9, 1927 (H. C. Severin) [SD]; Custer, 2 ♂ [MCZ, UN]; Elmira, ♀ [SD]; Hecla, ♀, June 19, 1933 (H. C. Severin) [SD]; Hot Springs, ♂ [AES]; Martin, 2 ♀, Aug. 25, 1929, Sept. 15, 1931 (H. C. Severin) [SD]; Rapid City, 2 ♀ [AES, UM, SD]; Sylvan Lake, ♀, Sept. 1, 1924 (H. C. Severin) [SD]; White River, Stanley Co., ♀, Sept. 1-5, 1913 (W. H. Over) [USNM].

WASHINGTON: Gulf of Georgia, ♀ (A. Agassiz) [MCZ]; Ilwaco, ♀, July 1918 (O. E. Miner) [WSC]; Little Spokane, ♂, July 26, 1882 [MCZ]; Pullman, ♂ [WSC]; Seaview, ♀, Sept. 12, 1918 (H. K. Plank) [USNM].

WASHINGTON TERRITORY: 10 ♂, 2 ♀ [AES, UM].

WYOMING: Bridge Basin, ♀ (S. Garman) [MCZ]; New Castle, ♂, July 1, 1911 (F. C. Bishopp) [USNM]; Yellowstone N. Park, ♀, July 23, 1930 [AMNH].

ALBERTA: Beaverlodge, ♀, July 19, 1931 (E. H. Strickland) [UM]; Gleichen, ♂, July 30, 1929 (H. L. Seamans) [CNM]; Lethbridge, ♂, ♀, July 7, 1909 (J. B. Wallis) [MCZ].

BRITISH COLUMBIA: Peachland, ♂, July 21, 1909 (J. B. Wallis) [MCZ]; Victoria, ♀ [AES].

MANITOBA: Aweme, ♀, July 3, 1917 (N. Criddle) [CNM]; Aweme, ♂, June 10, 1926 (R. M. White) [CNM].

SASKATCHEWAN: Regina, ♀, Aug. 8, 1886 (J. Fletcher) [CNM]; Rudy, ♀, July 19, 1907 (J. Fletcher) [CNM].

MEXICO: Escuinapa, Sinaloa (State), ♀ (J. H. Batty) [AMNH]; Meadow Vy., 2 ♀ (Townsend) [USNM, UM].

UNLABELED: ♂, 2 ♀ [UM].

Variations.—Male: length 10–16 mm.; margin of clypeus variable, sometimes appearing broadly transverse with a central emargination, sometimes appearing broadly rounded without any bending; frontal suture sometimes obsolescent in depression; some specimens with an obsolescent episternal suture below rectangle, and in one specimen this suture completely absent between rectangle and ventral side of thorax; fine sericeous hairs occasionally present on lower side of mesothorax; propodeal side and metapleuron sometimes with long distinct ridges; these plates occasionally heavily punctured giving them a very coarsely reticulated appearance; occasionally metanotal flange quite small; in a few specimens pilose hairs of meso- and metapleura and propodeum black basally and white apically, and very rarely pilosity entirely white on these plates. Female: length 12–18 mm.; very rarely clypeus slightly reticulate on lower part of bulge, in these cases not as glossy as typically; upper edge of clypeus sometimes scarcely marked.

This is one of the most difficult species to identify, due to its variations over its wide range. Only careful attention to a number of minute characters will separate *mickeli* from several closely related species in this genus. This is especially true in the males. The most closely related species are *compacta*, *robusta*, *sericea* and *occidentalis*. In the male *mickeli*: pilosity of head, and especially of clypeus, very dense; frontal depression short and crescent-shaped, otherwise frontal suture not depressed below rest of frons; metapleuron and propodeal side very heavily punctured, ridges not well-defined due to this punctation; metanotal flange moderate to large; petiole stout, heavier in middle below, thus with ventral side curving upwards posteriorly; dark part of abdomen always black; pilosity of thorax almost always entirely black. In the male *robusta*: pilosity of head only moderately dense; frontal depression elongated anteriorly, frontal suture depressed below rest of frons; ridges on metapleuron and propodeal side fairly distinct, large punctures not so abundant on these plates; metanotal flange moderate to small;

pilosity of thorax almost always white in specimens taken in the distribution range of *mickeli*; petiole slender, not distinctly bulging below; dark part of abdomen almost always a bluish-black or sometimes even a bright blue. In the female *mickeli*: clypeus very bulging, peak of bulge at about center of clypeus dorso-ventrally, area between peak of bulge and anterior margin glossy and without reticulation; area above bulge with a great many large punctures and many long black pilose hairs arising from them; petiole only slightly longer than hind coxa, stout, especially in middle below. In the female *robusta*: clypeus moderately bulging, peak of bulge being normally below center of clypeus dorso-ventrally, area between peak and anterior margin reticulate and not glossy; upper part of clypeus with only a few large punctures and only a few black pilose hairs; petiole distinctly longer than hind coxa, slender.

See also the notes following the descriptions of *compacta* and *occidentalis*.

23. *Podalonia compacta* Fernald

(Figures 20, 67, genitalia as in 17)

1927. *Podalonia violaceipennis* var. *compacta* Fernald, Proc. U. S. Nat. Mus. 71, Art. 9, p. 33. Male, female.

Male.—(Genitalia as in figure 17.) Head: clypeal margin extending downwards and inwards for a short distance, then bending and extending inwards but slightly downwards for the same distance, then curving upwards to center, forming a slight central emargination; lower part of clypeus with a slight suggestion of a reflexed condition; frontal suture distinct to anterior ocellus; a moderately long crescent-shaped frontal depression, surface granular and with no large punctures; except in frontal depression, frontal suture not depressed below level of frons; frons with many large and tiny punctures and a reticulate surface; pilosity of head moderately heavy, black. Thorax: collar narrowly rounded at top; episternal suture tending to become obsolescent below rectangle; mesopleuron with many large punctures, almost no tiny punctures, surface reticulate; metapleuron with prominent ridges which slant downwards and considerably forwards; propodeal side with prominent ridges, those on anterior part running forwards, remainder running forwards and downwards; metanotal flange quite small; pilosity of thorax black. Petiole: distinctly shorter than hind coxa and trochanter together, though longer than hind coxa alone; stout, and almost straight. Abdomen: first and second segments red,

third red with black markings dorsally and laterally; rest of abdomen black.

Female.—Length 15 mm. Head: clypeus moderately bulging, with many large punctures, some tiny punctures, and a smooth glossy surface; upper edge of clypeus scarcely marked. Thorax: metapleuron with ridges running almost due forwards. Petiole: stout, distinctly shorter than hind coxa, proportionate lengths being .91 for petiole to 1 for coxa. Abdomen: first, second, and third segments red, rest of abdomen black.

Redescribed from a male and a female deposited in the collection of Cornell University, Ithaca, New York; ♂, ♀, Harris, Humboldt Co., California, June 29, 1907 (J. C. Bradley).

Holotype.—Female, Sausalito, California; it is deposited in the collection of the American Museum of Natural History, New York.

Allotype.—Male, Sausalito, California; it is deposited in the collection of the American Museum of Natural History, New York.

Specimens examined: 5 ♂, 9 ♀; total specimens 14.

CALIFORNIA: 3 ♂, 4 ♀ [AES, UM]; ♀ [MCZ]; Harris, Humboldt Co., ♂, June 29, 1907 (Bradley) [CU].

OREGON: Corvallis, 2 ♀, July 1, 1910 (J. C. Bridwell) [USNM].

UNLABELED: ♀ [HF].

Variations.—Male: length 12–15 mm. Female: in one specimen first five abdominal segments red.

This species is most closely related to *mickeli*. The best characters to use in separating these two species are as follows. In the male *compacta*: metanotal flange small; petiole distinctly shorter than hind coxa and trochanter together. In the male *mickeli*: flange moderately large (in some specimens it is small); petiole about equal in length to coxa and trochanter, or slightly longer. In the female *compacta*: clypeus moderately bulging; proportion of petiole to hind coxa .91 to 1. In the female *mickeli*: clypeus strongly bulging; proportion of petiole to hind coxa 1.1 to 1. The male genitalia of these two species appear to be identical.

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