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SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY • 1970 NUMBER 43

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ZOOLOGY
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SMITHSONIAN INSTITUTION PRESS
CITY OF WASHINGTON
1970

ABSTRACT

Marston, Norman. Revision of New World Species of *Anthrax* (Diptera: Bombyliidae) other than the *Anthrax albofasciatus* Group. *Smithsonian Contributions to Zoology,* 43:1–148. 1970. A key is given to the species groups of *Anthrax* in North and South America. Four of the five groups are described and keys are given for included taxa. Each taxon is fully described, its synonymy is compiled, and its distribution is illustrated or summarized. Important taxonomic characters are illustrated. Sixteen taxa comprise the *oedipus* group, including *peruvianus, cordillerensis,* and *insulanus,* new species; and *irroratus striatipennis, oedipus aquilus,* and *pluto nigriventris,* new subspecies. Twenty-nine taxa comprise the *cephus* group, including *innubilipennis, inaquosum, nitidus, xanthomeros, hylaios, cathetodaithmos, snowi, costaricensis, koebelei, austrinus, clinopictus,* and *laticellus,* new species; and *argyropygus painteri,* new subspecies. Nine species comprise the *trimaculatus* group, including *baliopteros, latibasis,* and *caatingensis,* new species. Five taxa comprise the *tigrinus* group, including *xylocopae,* new species, and *simson habrosus,* new subspecies. Evolution of the *cephus* and *tigrinus* groups is discussed.

Contribution Nos. 897, 898, and 931, Department of Entomology, Kansas Agricultural Experiment Station, Kansas State University

Official publication date is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, Smithsonian Year.

UNITED STATES GOVERNMENT PRINTING OFFICE
WASHINGTON : 1970

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price $1.75 (paper cover)

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Introduction

The genus *Anthrax* is one of many poorly known taxa of Bombyliidae (Diptera) in the New World. Most of the species are based on inadequate descriptions, which resulted in misconceptions of the species and in many synonyms. It often has been impossible to determine identities of species except by studying the types (Painter and Painter, 1962). Additionally, many undescribed species have confused later authors attempting to determine identities of named species.

The genus is separated into five species groups for convenience in treatment. The *albofasciatus* group was revised earlier (Marston, 1963), leaving the *cephus, oedipus, trimaculatus,* and *tigrinus* groups to be treated here. A future study will deal with the known pupae. A description and the synonymy of the genus were given in the previous paper, while the key to the species groups is given herein.

The author wishes to thank the many people who have given advice and encouragement during the course of this study. Particular thanks are due to the late Dr. Reginald H. Painter of Kansas State University, whose enthusiasm and patient guidance were a continuous source of inspiration throughout the study. In addition, much of the basic taxonomic work was done with specimens in Dr. Painter's collection. Valuable assistance also was given by my wife, Barbara, and by Dr. Carl W. Rettenmeyer of Kansas State University.

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Thanks are also due to Prof. R. Defretin of the Musee d'Histoire Naturelle, Ville de Lille, for searching for the type of *Spogostylum mystaceum* Macquart, to Mr. Luis Peña of Santiago, Chile, for searching for the types of Philippi's species, to Dr. Karl-Johan Hedqvist of the Royal College of Forestry, Stockholm, Sweden, for furnishing information on types of *Nemotelus tigrinus* DeGeer, and especially to Dr. R. H. Painter for supplying notes on type specimens in European museums.

I am grateful to the following institutions and individuals for lending material on which the major portion of this study was based (abbreviations used in the text follow the name of each institution or individual): Academy of Natural Sciences of Philadelphia (ANSP), American Museum of Natural History (AMNH), British Museum (Natural History) (BM), California Academy of Sciences (CAS), Canadian National Collection (CNC), Chicago Museum of Natural History (CMNH), Cornell University (CNLL), Florida State Plant Board (FSPB), Illinois Natural History Survey (INHS), Instituto Oswaldo Cruz (IOC), Museu de la Plata (MLP), Museu de Historia Natural de Santiago (MHNS), Museum of Comparative Zoology (MCZ), Oregon State University (OSU), Riksmuseum of Stockholm (RIKS), Secretaria da Agricultura do São Paulo (SASP), Staatliches Museum für Naturkunde of Stuttgart (STUT), United States National Museum (USNM), Universidad de Tucuman (TUC), Universidade do Paraná (PAR), University of Arizona (ARIZ), University of California at Davis, Berkeley, and Riverside (UCAL), Snow Entomolog-

ical Museum at the University of Kansas (KANS), University of Michigan (MICH), University of Nebraska (NEBR), Washington State University (WSU), Messrs. Lawrence R. Ertle (ERTLE), Jack C. Hall (HALL), Karol Lenko (LENKO), R. H. Painter (RHP), Luis Peña (PEÑA), John Poorbaugh (JP), and Wolfgang K. Weyrauch (WEYRAUCH). The author's collection is designated (NLM).

In addition to support from the Kansas Agricultural Experiment Station, portions of this study were supported by National Science Foundation Grant G-21291 (Dr. Painter, principal investigator), a Fulbright Fellowship for study in Brazil, and National Science Foundation Cooperative Graduate Fellowships.

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Anthrax Species Groups

The species groups segregated in this paper are poorly defined and may be polyphyletic in some cases, or at least with some different species complexes arising from different Old World ancestors. No good diagnostic characters have been found to fit all species in a given group and the limits of some of the groups are open to question. The groups are used here only for convenience in separating the bulk of species in the genus into workable units and should not be construed as being equivalent to subgenera. A worldwide revision of the genus would be required to ascertain the relationships between Old World and New World species, and to learn the true identity and limits of the higher taxa for which some names have been proposed. The following key separates the groups of the genus present in North and South America.

Key to the Species Groups of the Genus *Anthrax* in North and South America

1. Pigmentation of wings solid, not broken into spots (Plate 2*r*); if wings nearly hyaline then setae on face extending almost to antenna (Plate 1*m*) ..... ***cephus*** group
   Wings with isolated or coalesced spots or with bands along veins; if mostly hyaline, then setae on face restricted to lower half and lateral margins (Plate 1*n*) 2
2(1). Cell $2M_3$ divided by a crossvein between m crossvein and vein Cu_2, wing veins margined with brown, discs of cells mostly hyaline (Plate 2*p*) ..... ***tigrinus*** group
   Cell $2M_3$ not divided by a crossvein; wings without bands along veins 3
3(2). Medial angle of m crossvein with a short spur and usually with a distinct spot, vein R_4 with a sharp medial angle and short spur (except in *A. cybele* Coq.); numerous spots usually present besides those at bases of cells (Plate 1*a–j*; Plate 2*a–o*) .... ***oedipus*** group
   Medial angle of m crossvein curved, without a spur or spot; medial angle of vein R_4 sinuate or evenly curved, without a spur. Spots on wings restricted to bases of cells (sometimes expanded), except sometimes medially in cell R_1 and medially on vein 2A (indistinct spots at tips of veins Cu_1 and Cu_2 and pigment extending along vein R_4 and m crossvein in one species) 4
4(3). Neotropical species ..... ***trimaculatus*** group
   Nearcitc species ..... ***albofasciatus*** group

Nomenclatorial History

Most of the descriptions of species of *Anthrax* by early authors were based on one or a few specimens and were so brief that it has often been impossible to determine the true identity of the species. The lack of communication among the early authors also resulted in the creation of many synonyms, which has further inhibited the work of recent students. Only since a study of the types of North and South American Bombyliidae was made by Painter and Painter (1962 and unpublished notes) has it been possible to undertake a complete revision of the genus *Anthrax*. The species *Anthrax midas* Fabricius, for example, had not been recognized from the time it was described and had been placed in the genus *Villa* (*Anthrax,* auctt.) in catalogs until it was studied by Painter and Painter.

Outside the *albofasciatus* group, the first New World species of *Anthrax* was described as *Nemotelus tigrinus* by DeGeer (1776). During the first two-thirds of the nineteenth century most authors placed their species in the genus *Anthrax,* which was then interpreted more widely than at present. The first five species to be described were *oedipus, simson, cephus, midas,* and *gideon* by Fabricius in 1805. All were from South America. These were followed by Say's (1823) descriptions of *analis* from Georgia, *irroratus* from the

Rocky Mountains, and *scriptus,* a synonym of *tigrinus,* from Pennsylvania. Wiedemann (1828) described several species in the genus *Anthrax,* among which were *acroleucus* and *hyalacrus* from Brazil, *argyropygus* for which he gave the locality "Vaterland?," and *pluto* from Kentucky. He was confused as to the range of variation of *gideon,* and *acroleucus* is a synonym of it. Macquart (1834) described *georgicus,* a synonym of *analis,* from Georgia, added *angustipennis* and *luctuosus* from French Guiana, *funebris* from the Dominican Republic in 1840, and *"irrorata,"* a synonym of *irroratus* Say, from Carolina and Georgia. Also in 1840, he described *mystaceus* from Brazil or Chile in the new genus *Spogostylum.* In 1845 he described *binotatus,* which has been shown to be the female of *angustipennis,* in 1848, *trimaculatus* from Brazil, and in 1849, *Exoprosopa punctata,* a synonym of *oedipus* Fabricius from "Amer. Merid." In 1855, Macquart named *leucopygus* from South America, apparently without realizing that this was a homonym of *leucopygus* Macquart, 1840, from Timor. D'Andretta and Carrera (1952) proposed the name *macquarti* to replace the junior homonym.

Among the many species described by Walker in the *cephus* group were *delicatulus* in 1849 from Jamaica, followed by *repertus* from South America, *cedens* from the United States and *punctum* and *aequa* from Brazil in 1852, and *inexactus* from the Amazon in 1857. It is shown here that *cedens* is simply a form of *analis* and that *inexactus* is only a variant of *repertus,* while *punctum* and *aequa* are synonyms of *oedipus* Fabricius. Blanchard (1852) described *vicinus* from Chile, but the name was preoccupied by *vicinus* Macquart (1840). Rondani proposed the name *inordinatus* for the same species in 1863. Philippi added *squalidus, bellulus,* and *deodecimpunctatus* from Chile in 1865. The latter is regarded as a synonym of *mystaceus* (Macquart).

During the last third of the nineteenth century most authors placed the present species of *Anthrax* in *Argyramoeba* and several species were described in this genus. Schiner (1868) described *propinqua, caloptera* and *imitans* from Venezuela, and *poecilophora* from Chile. *Anthrax propinquus* is now applied to a form of *gideon* from northwest South America, while *caloptera* is a synonym of *oedipus, imitans* is a synonym of *trimaculatus* and *poecilophora* is a synonym of *inordinatus.* In 1869, Loew described *contigua* from Virginia, a synonym of *argyropygus,* along with *delila* from California and *stellans* from Oregon. Osten Sacken (1886) described *sereipunctatus* from "N. Sonora." Bigot (1892) added *albosparsa* from "Colorado," *aterrima* from Maryland, *melanopogon* from Washington, and *plurinota, crinita,* and *inappendiculata* from Chile. It is shown here that *crinitus* is a synonym of *squalidus* while *inappendiculatus* is a synonym of *bellulus.* Bigot also described a headless specimen as *Hemipenthes latelimbatus* from "Carolina." The latter is a synonym of the form *cedens* of *analis.* The last species described in the 1800s was *Argyramoeba cybele* Coquillett (1894) from southern California.

From 1900 to 1920, species of *Anthrax* were placed in either *Argyramoeba* or *Spongostylum.* Williston (1901), however, placed his new species, *pluricellus,* from Vera Cruz, Mexico, in *Anthrax,* which then was interpreted as *Villa* is now. Johnson (1913) studied the species of *Anthrax* (then *Spongostylum*) related to *analis* and described *slossonae* from Kentucky, *occidentalis* from the western United States, and *grossbecki* from Florida. It has been shown that *slossonae* is a synonym of *aterrimus, occidentalis* is a synonym of *analis,* and *grossbecki* is only a form of *analis.* In 1919, Cole added *Spongostylum argentatum* from Oregon. The last species to be described were *Anthrax guianicus* Curran (1934) from British Guiana, *minimaculatus* Oldroyd (1937) from Argentina, and *cintalpa* and *mexicanus* Cole (1952) from Chiapas, Mexico. *Anthrax guianicus* and *mexicanus* are synonyms of *midas* Fabricius.

Taxonomic Characters and Techniques

The characters used for separation of species vary between groups and are therefore discussed under each group. In general, the wings offer the most useful characters and these are illustrated for almost all species. The Comstock-Needham system is followed in naming the veins and cells for the most part.

The male and female genitalia present useful characters in most groups and are therefore illustrated. The terminology is artificial in part, so the specific structures are named in Figures 8, 50, and 128.

The techniques for preparing the genitalia may be useful to other students. First, the specimens to be studied are placed in a relaxing jar for approximately six hours. This is long enough to preclude breakage during handling, yet is not so long that the insects become wet, thus destroying the patterns of scales and pollen. The specimen is grasped with forceps near the apex of the abdomen and the genitalia are removed

with an insect pin. Care should be taken to remove all of the sixth sternum of the female or the bulbs of the spermathecae may be broken off. The genitalia are then placed in a solution of potassium hydroxide (about 10%) in a shell vial and left to soak at room temperature for 24 hours. At the end of this time the softer tissues are removed and the genitalia are ready for study. By this method, a relatively large number of specimens may be handled at one time.

The genitalia are glued to the tip of an insect pin with clear fingernail polish—the male genitalia attached ventrally at the junction of the gonocoxites and the female genitalia exteriorly just below the cerci. The pin is then placed in a dish of glycerine on two paper clips. A third paper clip is placed over the pin to hold the pin in place after the specimen has been positioned for drawing. The glycerine prevents the nail polish from hardening so that the specimen's position may be adjusted on the pin, and it may be easily removed. After the drawings are completed the genitalia may be preserved in a small vial pinned below the specimen.

Maps illustrate the distribution of species that are known from more than a few specimens. Each dot represents a locality from which one or more preserved specimens have been seen. The hypothetical ranges (shown by shading) indicate areas ecologically similar to areas from which specimens have been recorded and were drawn primarily from vegetation maps of the areas under consideration.

Biology and Ecology

Species of the genus *Anthrax* are all parasitoids on larvae of holometabolous insects living in tubular nests or cells as far as is known. Life histories of the species are probably similar to that of *Anthrax limatulus fur* (Osten Sacken) described by Marston (1964), with eggs deposited in openings of cells in a variety of nest locations, depending upon the species. Specimens have been collected in almost every conceivable ecological area from the northernmost extensions of the Arctic forests to south Chile.

The *oedipus* group is composed of two distinct species complexes distinguishable by differences in wing pattern. The *oedipus* subgroup occurs throughout North and South America and contains well-defined species, which seem to have been distinct for a relatively long time as evidenced by the diversity of morphological structures, especially the male and female genitalia. The *pluto* subgroup, on the other hand, is found only in North America and the West Indies. The species seem to be very closely related, except for *A. cybele,* and show only minor differences in morphological structures. It seems probable that the two subgroups were derived from separate Eurasian ancestral stocks with the *oedipus* subgroup arriving in North America much earlier. *Anthrax cybele* probably also was derived from a separate ancestor, but it is included within the *pluto* subgroup for convenience.

The species of the *oedipus* group, primarily inhabitants of open forested areas with some adapted to desert areas with xerophytic shrubs, parasitize a wide range of higher Hymenoptera nesting in old logs and stumps, in banks, and in soil. The species collected by the author seldom leave their local habitat and never have been taken on flowers. Females often are seen ovipositing on old stumps and logs, in cracks and holes in vertical banks, and occasionally in holes in open, flat areas. They sometimes are attracted to the collector and will oviposit on dark spots on clothing. Little is known about the biology of the species other than host records. The little information available indicates that their life history is similar to that of *A. limatulus fur* (Osten Sacken) (Marston, 1964).

With the exception of *analis* and *argentatus,* the species of the *cephus* group occur predominantly in warm temperate and tropical climates. By far the greatest number of species occur in the area between southern Mexico and southeastern Brazil. *Anthrax argentatus* probably was derived from an ancestral form adapted to a cold temperate climate, since related species occur in the Palaearctic region, and it now occupies a range from southwestern Canada south in the mountains to central California and Colorado. *Anthrax analis,* on the other hand, probably has become adapted secondarily to cold climates as well as warm ones, since its closest relatives are Neotropical and it now may be found into north-central Canada. Apparently no species of the *cephus* group has been able to adapt itself to the temperate climates of southern South America. The southernmost record is for *gideon* from Montevideo, Uruguay.

Ecologically, the species of the *cephus* group predominantly are found in forest habitats (including forest glades), although several species have become adapted to drier areas. *Anthrax nitidus* is found in the desert area of southern California and southwestern Arizona, although its closest relative, *argentatus,* is found in forested areas. Several species have become

adapted to the dry climate of northeastern Brazil, but these usually also occur in forest areas, indicating that the adaptation is relatively recent or that they occupy habitats that are similar in the two areas. The latter may be the case with *repertus,* which has been collected in grassy areas in the tropical forest of southeast Brazil. *Anthrax inaquosum* is the only species restricted to the desert of northeast Brazil as far as is known. *Anthrax analis* is unique in the group (with the possible exception of *funebris*) in that it has become adapted to sandy areas where it has been reared from the larvae of tiger beetles (Cicindellidae).

Little is known of the biology of the species. With the exception of *analis,* the only records of hosts are from wasps (Hymenoptera: Sphecidae). The species probably parasitize a wide range of holometabolous insects within the limits of their preference for oviposition sites.

The *trimaculatus* group is restricted to South and Central America as far as is known. The species apparently are found throughout the continent, although, due to lack of collecting, large gaps occur in such areas as southern Argentina. The species have been collected in a variety of habitats, along paths, in clearings, and flying over vertical banks, where wild bees were nesting. They seem to fill niches similar to those occupied by the species of the *albofasciatus* group in North America. Biological notes are available only for *trimaculatus,* a specimen of which was reared from the nest of a species of *Diadasia* (Hymenoptera: Apoidea).

The species of the *tigrinus* group occupy a variety of habitats, although each is apparently restricted to a broad ecological zone. All reared specimens have been taken from the nests of species of *Xylocopa* (Hymenoptera: Apoidea), although they may also parasitize species of related genera with similar nesting habits. The facts known of the biologies of the species are discussed by Hurd (1959), although he considered the entire group to be a single species, *Anthrax simson* Fabricius.

Anthrax tigrinus is known from the eastern deciduous forests so that its range is limited on the north by the coniferous forests and on the west by the Great Plains. Similarly, *delila* is found in broadleaf deciduous and evergreen forests in southern and central California, although it occurs in areas dominated by coniferous forests in northern California. A relict population also occurs in southern Baja California. Both *tigrinus* and *delila* have been reared from species of *Xylocopa* nesting in structural timbers.

Anthrax xylocopae has become adapted to drier areas than are inhabited by *tigrinus* and *delila,* since it occurs in pinion–juniper forests and grasslands from eastern Arizona and north-central Mexico to central Texas. It has been reared from *Xylocopa* nests in dead-flower stalks of *Yucca* and probably parasitizes bees nesting in deadwood as well. In central Arizona *xylocopae* is allopatric to *simson habrosus,* the latter occurring in desert areas from southern California and Arizona south along the Pacific coast of Mexico and in dry tropical forests in southern Mexico as far east as Chiapas. No reared specimens of *s. habrosus* have been studied, but it probably parasitizes *Xylocopa brasiliorum varipuncta* Patton, which nests in a variety of woods throughout southern California, western Arizona, and northwestern Mexico. *Anthrax simson simson* occurs in wet tropical forests in eastern Mexico, Central America, and northern South America. Nothing is known of its biology; the record cited by Hurd of a bombyliid taken from the nest of *Xylocopa augusti* Lepeletier at Araucaria, Paraná, Brazil, might refer to *simson.*

Anthrax oedipus Group

The *oedipus* group is a well-defined aggregate of species in North and South America. They generally are characterized by numerous spots on the wings at the bases of the cells, on apices of veins, and often scattered along veins and expanding into the cells. Setae on the face are concentrated along the epistomal margin with a few along the eye margins (Plate 1*n*). Light and dark scales on the thorax and abdomen are formed in a complex pattern with some enlarged and truncate along the posterior and lateral margins of the abdominal terga. The gonocoxites of the male genitalia taper apically and are not lobed; the distal segment of the gonostylus is flat, quadrangular basally, and ends in a deflexed hook. The base of the third antennal segment is wider than the second segment, hemispherical, and more or less as long as the styliform part.

Group Description

Body generally black, blue gray or brown pruinose, gray or silvery pollinose along eye margins; femora, tibiae, male genitalia, and basal antennal segments sometimes dark red or orange. Front with black setae and, on lower half, lanceolate scales. Face retreating, epistomal margin abrupt; upper half of face bare ex-

cept for some setae and a few scales along eye margins; lower half of face with coarse black setae and linear or oblanceolate white or yellowish scales extending along eye margins into oral cavity (Plate 1*n*). Occiput with short, semirecumbent black setae and linear and lanceolate scales; fringe of pile on posterior margin dark brown or black, sometimes with light tips. First antennal segment narrow basally, enlarged mesad apically, slightly shorter to slightly longer than apical width. Second segment lenticular with apical margin rounded (Figure 15; Plate 1*k*) or saucer shaped with apical margin produced as a sharp flange (Figures 14, 16; Plate 1*l*); base of third segment bulbous, slightly wider than second segment in male, distinctly wider in female; styliform part arising medially or toward lateral margin, slightly shorter to distinctly longer than basal part; style short, about one-fourth as long as styliform part, tuft of hairs about as long as style.

Disc of mesonotum with sparse, fine black setae and linear, mostly black scales; white scales in transverse line in front of bases of wings, in submedial longitudinal lines on anterior half, along anterior edge, and in a triangle extending forward from posterior margin; brown scales sometimes intermixed with white and occasionally predominating on disc. Lateral margins of mesonotum with black setae and bristles and linear or elongate, threadlike, white or brown and white scales. Scutellum with linear or lanceolate black scales on disc and lanceolate, oblanceolate or obovate white scales on anterior and posterior margins; brown scales often intermixed with white, white or brown scales sometimes in medial patch on disc, black scales occasionally restricted to submedial spots. Sternopleuron, lower half of mesopleuron, and anterior half of pteropleuron with black setae and linear or lanceolate, recumbent to erect scales; some coarse setae on pteropleuron. Upper half of mesopleuron with coarse black or gold setae, and curly scales; pile sometimes present. Pile on prosternum, propleuron, and anterior margin of mesonotum white, black or mixed, some brown hairs often present, black setae present on anterior margin of mesonotum. Postalar tuft of pile black, white or yellowish brown, occasionally mixed, usually a few white scales at base. Hypopleuron bare, metapleuron usually bare, sometimes with a few scales behind and below spiracle. Coxae with black setae and black or white lanceolate or oblanceolate scales, occasionally with some brown scales.

Wing with basal infuscation extending into basal cells and with numerous spots in apical part of wing at bases of cells and usually at angles and apices of veins, sometimes also at other points on veins; spots often more or less coalesced into medial and subapical bands and sometimes elongated into transverse striae. Cells C and Sc with alternating hyaline and pigmented areas or entirely hyaline, subhyaline, or infuscated. Spurs at bases of cells R_{2+3} and R_4, and at medial angle of m crossvein, and often at medial angle of vein R_4 and basal angle of m crossvein; spur at base of cell R_4 sometimes connected to vein R_{2+3} to form a sectoral crossvein. Anal cell slightly open or closed in margin; r–m crossvein at basal third or two-fifths of discal cell; junction of cells $1M_2$ and Cu_1 one to three times length of base of cell Cu_1. Cell 2A one to 1.5 times as wide as cell 1A; alula well developed; calyptere unpigmented, fringe of hairs white (Plate 1*a–j*; Plate 2*a–o*). Stem of halter brown, base of knob dark brown, apex of knob white.

Femora with oblanceolate-cuneate or obovate-cuneate scales, usually black anteriorly and white posteriorly on fore and middle pairs, entirely black or white posteroventrally and black anterodorsally on hind pairs; black scales sometimes more or less replaced by brown. Scales on tibiae usually white posteriorly and black anteriorly on fore and middle pairs, entirely black on posterior pairs. Fore femora with anteroventral row of bristles strongest toward base; middle femora with posteroventral row of bristles and occasionally with one or more bristles postmedially on anterior surface; hind femora with anteroventral row of bristles in female and additional posteroventral row in males.

Lateral margin of first abdominal tergum with white pile and a few black setae, occasionally some black pile, sides of second tergum with black setae and linear, lanceolate, oblanceolate or obovate-cuneate scales of variable color, occasionally some black pile; sides of posterior terga with oblanceolate and obovate-cuneate scales of variable color, occasionally some black pile; sides of posterior terga with oblanceolate and obovate-cuneate scales and black setae. Posterior margins of first tergum with a few black setae and with light scales laterally and dark scales medially; discs of remaining terga with sparse setae and complex pattern of linear or threadlike to ovate-cuneate scales; usually with broad white scales in submedial or medial and sublateral patches on posterior margins, less distinct posteriorly; smaller scales cover remainder of disc,

brown or white in basal and subapical, poorly defined bands on second segment and basally on posterior segments, black elsewhere. Sterna with sparse black setae and linear or threadlike to ovate scales; light scales usually predominate posterolaterally and dark scales anteromedially.

Apex of gonocoxites of male genitalia simple, not elongated into lobes. Basal segment of gonostylus platelike, rounded dorsally, not produced apically; distal segment laterally flattened, quadrangular basally, apex a deflexed hook. Apex of epiphallus small, curled upward at tip dorsally, slightly flared laterally, with a basally produced spine just after junction of dorsal bands; epiphallus sometimes atrophied. Apex of aedeagus acute with gonopore ventral, or flared with gonopore apical, sometimes trilobed. Base of aedeagus bulbous, narrowing abruptly to apical part. Epandrium simple or with dorsal margin apically produced and with cerci produced ventrad.

Tenth tergum of female with four to twelve spines on each side. Sclerite on each side of gonopore hatchet shaped; lateral lobe acute, clavate or broad and blunt; dorsal or dorsomedial lobe short, acute or obtusely rounded; ventral lobe narrow and parallel sided or broadened medially, curving inward at apex. Ducts of spermathecae uniting medially into common duct or sometimes emptying separately into genital chamber, with one to seven convolutions before expanding to bulbs; bulbs elongate, expanded medially, postmedially or sometimes apically, sometimes bent medially or basally.

Taxonomic Characters

The wings of the species of the *oedipus* subgroup show many differences between taxa, but the differences in pattern are subtle and difficult to describe (Plate 1*a-j*). That difficulty apparently has led some authors to lump all the species together in despair, although other less readily observed characters will separate the species. Discrete differences in the pattern of the wings often are obscured by variation in intensity of the pattern in different localities. That is especially true of *irroratus irroratus* where the wings vary from lightly to heavily pigmented in different parts of North America (Plate 1*a–c*). In the *pluto* subgroup the wing pattern remains almost the same (except for *cybele*), while differences between the species are due to restriction or extension and coalescence of spots (Plate 2*a–o*). The sexes vary in this subgroup with females having darker wings. The spur at the base of cell R_4 may be connected to vein R_{2+3} to form a complete sectoral crossvein in the *oedipus* group. The character is stable in some species; in others it varies.

In most species of the *oedipus* group the second antennal segment is saucer shaped with the apical margin produced as a sharp flange (Figures 14, 16; Plate 1*l*), a character shared with many Palaearctic species. Only two species in the group, *irroratus* and *cybele,* have the second segment lenticular (Figure 15; Plate 1*k*) as it is in all other groups of the genus in North and South America except the *tigrinus* group. This is another character used to separate the "genera" segregated in the Old World by Sack (1909) and Bezzi (1924), but which is not applicable to New World species.

The chaetotaxy of the legs seldom has been found useful to separate species in the Bombyliidae and that is generally true in the genus *Anthrax. Anthrax oedipus* and *peruvianus,* however, have a distinctive bristle on the middle femur postmedially on the anterior side, which has not been noted in other species in the group (Figure 30). That is one of the qualitative characters that lead to the conclusion that the *oedipus* subgroup has evolved longer in the New World than has the *pluto* subgroup.

The male genitalia are of little practical use to separate species in the *oedipus* group, contrary to the situation in the *albofasciatus* group. While some good internal differences exist, external aspects of the genitalia are quite similar for almost all of the species. The most striking differentiation is in *cordillerensis* and *inordinatus* of the *oedipus* subgroup in which the apex of the epiphallus is atrophied and the apex of the aedeagus trilobed. Females of the species appear to be adapted to the trilobed aedeagus in that they have three spermathecal ducts emptying separately into the genital chamber rather than uniting into a common duct. Those two species also have the epandrium elongated over the cerci so they project ventrad. Female genitalia have several good internal characters, the shape of the spermathecae, the number of convolutions in the spermathecal ducts, and the shape of the sclerites on each side of the apex of the spermathecal ducts, but a part of the abdomen has to be destroyed to examine them.

Variation in vesture of the body is extensive. In general, there appear to be four types of ectodermal processes in the genus—macrochaetae (or bristles),

setae, pile (hairs), and scales—although the cellular origins of the different types have not been investigated. While both setae and macrochaetae are tapered, macrochaetae usually are larger, few in number, and found in well-defined locations, whereas setae are finer, more numerous, and more or less scattered where they occur. Pile is formed of erect, parallel-sided hairs with minutely bristly apices. No intermediate structures have been found between pile and scales in the genus *Anthrax*. Scales are the most variable component of the vesture, in color, shape, and size, and often present useful characters. They may be white, black or various shades of brown, and vary from short and linear or lanceolate to long, ovate-truncate. Some of the various shapes discriminated are illustrated in Figures 17–26. An accurate classification is impossible since all sizes and shapes intergrade. "Tomentum" has been used in other genera of Bombyliidae for dense, woolly, hairlike scales, but such have not been observed in the genus *Anthrax*.

Key to the North and South American Species of the *oedipus* Group of the Genus *Anthrax* Scopoli

1. Cells C and Sc of wing with alternating pigmented and hyaline areas (except rarely in *A. cordillerensis* from Chile). Veins in outer part of wing with numerous spots other than at bases of cells and at apices of veins (Plate 1*a–j*). North and South America. ***Anthrax oedipus*** subgroup 2

   Cells C and Sc of wing without alternating pigmented and hyaline areas, either evenly infuscated or partly or wholly hyaline or subhyaline. Veins in outer part of wing without spots other than at bases of cells, apically on some veins, subapically on vein R_{2+3} and submedially on R_4 (Plate 2*a–o*). North America and West Indies. ***Anthrax pluto*** subgroup 10

Anthrax oedipus subgroup

2(1). Second antennal segment lens shaped, rounded apically (Figure 15; Plate 1*k*). North America 3

   Second antennal segment saucer shaped, produced apically as a sharp flange (Figures 14, 16; Plate 1*l*). North and South America 4

3(2). Wing with some independent rounded spots, usually many (Plate 1*a–c*). Usually numerous white scales anteriorly on second and following abdominal sterna. Small subspecies, wing length 4.9–9.2 mm. North America other than Arctic tundra, coastal plain of southeastern United States and Central America (Map 1) ..... ***irroratus irroratus*** Say

   Wing with dense pattern of transverse striae; with few, if any, independent rounded spots (Plate 1*d*). Abdominal sterna without white scales anteriorly. Large subspecies, 7.4–9.8 mm. Florida north to South Carolina and west to Alabama (Map 1) ..... ***irroratus striatipennis***, new subspecies

4(2). Cell Sc of wing evenly infuscated or subhyaline, or with indistinct spots. Chilean and Peruvian species 5

   Cell Sc of wing with distinctly alternating pigmented and hyaline or subhyaline areas. Southwestern United States, Mexico, West Indies, and South America other than Chile 7

5(4). Middle femur without bristles above anteroventral row (Figure 36). Abdominal terga without golden brown scales, wing with complete sectoral crossvein. Chile 6

   Middle femur with distinctive bristle or bristles on anterior side above anteroventral row (Figure 37). Abdominal terga with large patches of golden brown scales. Wing without complete sectoral crossvein. Southwestern Bolivia (?) to Ecuador (Map 4). ..... ***peruvianus***, new species

6(5). Wing with complete sectoral crossvein (Plate 1*i*). Femora orange. Abdomen with large patches of golden brown scales. Central Chile and southwestern Argentina (Map 5). ..... ***inordinatus*** (Rondani)

   Wing without complete sectoral crossvein (Plate 1*j*). Femora black. Few, if any, golden brown scales on abdomen. Andes Mountains in central and southern Chile, and southwestern Argentina (May 4) ..... ***cordillerensis***, new species

7(4). Middle femur with distinctive bristle on anterior side above anteroventral row (Figure 37). Postalar tuft of pile white or black. Mexico and West Indies through South America other than Chile 8

Middle femur without bristles anteriorly above anteroventral row (Figure 36). Postalar tuft of pile usually black or with few white hairs. Southwestern United States to Venezuela and Colombia (Map 2) ..... ***cintalpa*** Cole

8(7). Dorsum of abdomen with black and white scales, no large patches of brown scales. Abdominal sterna three, four, and five with numerous black scales. Lateral margins of second tergum with only black scales and pile. Mexico and West Indies through South America other than Chile and Peru (Map 3) 9

Large patches of golden brown scales on abdominal terga. Few, if any, black scales on third, fourth, and fifth sterna. Lateral margins of second tergum with tuft of brown and white scales posteriorly. Southwestern Bolivia (?) to northern Peru (Map 4) ..... ***peruvianus***, new species

9(8). Wing with complete sectoral crossvein (Plate 1*n*). Postalar tuft of pile black. Southern Brazil and adjacent areas (Map 3) ..... ***oedipus aquilus***, new supbspecies

Wing without complete sectoral crossvein (Plate 1*g*). Postalar tuft of pile white. Southern Mexico to southern Brazil and northern Argentina (Map 3) ..... ***oedipus oedipus*** Fabricius

Anthrax pluto subgroup

10(1). Second antennal segment saucer shaped, apical margin produced as a sharp flange (Figures 14, 16; Plate 1*l*). Independent spots usually present apically on vein R_{2+3} or medially on R_4 11

Second antennal segment lens shaped, apical margin rounded (Figure 15; Plate 1*k*). Independent spots absent apically on vein R_{2+3} and medially on R_4 (Plate 2*o*) ..... ***cybele*** (Coquillett)

11(10). Cell 2M of wing hyaline except at extreme base and apex. Vein 2A with at most a faint cloud submedially in some females (Plate 2*c–d*) 12

Cell 2M of wing partially or completely infuscated medially. Vein 2A with at least a small cloud submedially in males and with a distinct spot in females (Plate 2*a–b*, *e–n*) 13

12(11). Abdominal sterna one through three with long, linear, white scales predominating. Sternopleuron and lower halves of mesopleuron and pteropleuron with white scales only. Terga two through five usually with linear white scales across entire posterior margins or narrowly broken medially by black scales. Texas to southern California, south into Sonora and Baja California (Map 8) ..... ***seriepunctatus*** (Osten Sacken)

Abdominal sterna one through three with few, if any, linear white scales. Sternopleuron, and lower halves of mesopleuron and pteropleuron with mixed black and white scales. Posterior margins of terga two through five with submedial and sublateral patches of lanceolate or cuneate white scales interrupted by areas of black scales. Texas to southern California, south into Mexico and north into Great Basin (Map 9) ..... ***atriplex***, new species

13(11). Scales on hind femur entirely black or with few white ones posteriorly at base. Underside of abdomen with few, if any, golden brown scales; numerous black scales often present 14

Hind femur with golden brown scales ventrally and black scales dorsally. Long, curly scales on abdominal sterna two through seven white on posterior margins, golden brown subapically and sometimes basally; few, if any, black scales present. Canada south in Coast Ranges and Sierra Nevada to southern California, in Rockies to Colorado and in Appalachians to Georgia (Map 8) ..... ***stellans*** (Leow)

14(13). Upper half of mesopleuron with mixed black, white, and often brown hairs, and black setae. Pile on lateral margins of first abdominal tergum often yellowish white or with some black hairs posteriorly. Continental North America 15

Upper half of mesopleuron with dense, snowy white pile and few yellow or black bristles, no black or brown hairs present. Lateral margins of first abdominal tergum with snowy white pile. West Indies (Map 7) ..... ***insulanus***, new species

15(14). Cell 2M entirely infuscated or with at most a small medial subhyaline area in some males. Submedial spot on vein 2A broadly connected to base (Plate 2*e–f*). Eastern United States, Texas, and eastern and southern Mexico (Map 6) 16

Cell 2M with at least a small subhyaline area in females, largely hyaline in males. Submedial spot on vein 2A separated from base (Plate 2*k–n*). Western United States, Texas, and northern Mexico 17

16(15). Abdominal sterna one through three with threadlike, mostly white scales, with a few black ones on two and three. Lateral margins of first abdominal tergum with white pile ventrally, with few black hairs posteriorly. Mississippi valley from Appalachians to Great Plains, south to Oklahoma and Tennessee (Map 6) ..... ***pluto pluto*** Wiedemann

Scales on abdominal sterna two through seven entirely black, or few white ones present on posterolateral margins. Ventral part of lateral margins of first abdominal tergum with black pile or with few white hairs intermixed. Texas to Florida, south along Gulf coast to south-central Mexico (Map 6) ..... ***pluto nigriventris***, new subspecies

17(15). Scales on abdominal sterna two through seven mostly black, few white or yellow ones sometimes present along posterior margins. Postalar tuft of pile usually predominantly white. Dry oak or mesquite forests from southern California to Texas and into northern Mexico (Map 9) ..... ***atriplex***, new species

Abdominal sterna with long, threadlike white scales, sometimes with few black scales medially on three through seven. Postalar tuft of pile usually predominantly black. Coniferous forests from southern California to British Columbia and south in Rocky Mountains to northern New Mexico (Map 10) ..... ***melanopogon*** (Bigot)

Anthrax irroratus irroratus Say

Anthrax irroratus Say, 1823, p. 46.—Osten Sacken, 1858, p. 40 [*irrorata*].—Say, 1859, p. 61.—Curran, 1927, p. 85 [*irrorata*].—Maughan, 1935, p. 33 [part] [*irrorata*].—Priddy, 1939, p. 45 [*irrorata*].—Brooks, 1952, p. 370 [*irrorata*].—Painter and Painter, 1965, p. 432.—Krombein, 1967, p. 403.

Anthrax irroratus Macquart, 1840, p. 60 [*irrorata*].—Macquart, 1848, p. 34 [*irrorata*].—Osten Sacken, 1858, p. 40 [*irrorata*].

Anthrax oedipus.—Wiedemann, 1828, p. 262.—Osten Sacken, 1858, p. 41 [part].—Johnson, 1925, p. 108.—Curran, 1927, p. 85.—Edwards, 1930, p. 173 [part].—Brimley, 1938, p. 341.—Strickland, 1938, p. 195.—Hall, 1954, p. 146 [not Fabricius, 1805; misidentification].

Argyramoeba oedipus.—Osten Sacken, 1877, p. 243 [part].—Osten Sacken, 1878, p. 90 [part].—Osten Sacken, 1886, p. 102 [part].—Townsend, 1893, p. 60.—Coquillett, 1894, p. 95 [part].—Davidson, 1894, p. 170.—Baker, 1895, p. 173.—Kertész, 1909, p. 66 [part].—Malloch, 1917, p. 392.—Rau, 1926, p. 231 [*Argyromoeba*] [not Fabricius, 1805; misidentification].

Spongostylum oedipus.—Aldrich, 1905, p. 223 [*Spogostylum*].—Cole and Lovett, 1921, p. 244 [*Spogostylum*].—Cole, Malloch, and McAtee, 1924, p. 185 [*Spogostylum*] [not Fabricius, 1805; misidentification].

MALE.—Head with black setae and lanceolate, black and white scales. Second antennal segment lenticular, apex not produced as sharp flange (Figure 15; Plate 1*k*); base of third segment bulbous, about 1.33 times wider than second segment, styliform part about 1.33 to 1.5 times longer than base, about 2 to 3 times longer than style.

Mesonotum and scutellum with linear, black and white scales, curly along margins, brown scales sometimes present. Anterior half of pteropleuron, mesopleuron, and sternopleuron with black setae, and black, white, and sometimes brown pile and scales. Pile on prosternum, propleuron, and anterior margin of mesonotum white or mixed black and/or brown and white. Postalar tuft of pile black, often with some white or brown hairs, rarely completely white. Metapleuron sometimes with patch of lanceolate white or yellowish-white scales in specimens from western United States. Coxae with black setae and white or mixed black and white scales.

Cells C and Sc with distinct spots alternating with hyaline areas; remainder of wing with dark brown spots varying greatly in number and extent (Plate 1*a–c*), specimens from eastern United States with spots coalesced into broad subapical, medial, and basal bands and with some independent spots elongated transversely; specimens from western United States usually with spots smaller, rounded and not coalesced into bands; specimens from Canada grading from heavily pigmented eastward to lightly pigmented westward; specimens from Mexico with spots sometimes coalesced into bands, but with independent spots rounded. Spur at basal angle of cell R_4 rarely connected to vein R_{2+3} to form a sectoral crossvein. Basal

part of vein Cu_1 0.33 to 0.5 as long as complete vein.

Scales on fore and middle femora usually black anteriorly, white or yellowish white posteriorly, sometimes with few black scales posteriorly, often with white scales anteriorly; scales on hind femur varying from entirely black to predominantly white. Middle femur without a bristle anteriorly above anteroventral row.

Sides of first abdominal tergum with white pile and some black setae; posterior margin with black scales medially and white scales laterally. Lateral margins of remaining terga with short, obovate-truncate to long oblanceolate black scales and few black setae and hairs, with white scales posteriorly on three, sometimes on four and five, and predominating on six and seven. Discs of terga with linear black scales anteriorly, and with submedial and sublateral patches of ovate-truncate white scales on posterior margins; lanceolate white, yellowish-white and/or brown scales often present anteriorly; white scales on posterior margins often coextensive on posterior terga and spreading over discs of sixth and seventh terga. Venter with sparse black setae and sparse lanceolate scales, usually entirely white or yellowish white, sometimes partly or entirely black.

FEMALE.—Similar to male. Base of third antennal segment more enlarged, about 1.5 times wider than second segment. White scales on posterior abdominal terga less extensive.

MALE GENITALIA (Figure 9).—Apical part of gonocoxites about three times longer than basal part; distal segment of gonostylus about twice as long as wide. Apex of epiphallus with sharp flange dorsally; no medial process above apex of aedeagus. Apex of aedeagus not flared; gonopore ventral. Epandrium rounded apically in dorsal view; cercus projecting apically beyond epandrium.

FEMALE GENITALIA (Figure 38).—Tenth tergum with nine spines apically on each side; ventral extension from base narrowed apically. Dorsal part of sclerite on each side of gonopore strongly produced above lateral lobe and broadly rounded; lateral lobe truncate, apex acute dorsally, obtuse ventrally; ventral extension narrowed apically and strongly curved mesally. Ducts of spermathecae united into medial tube before emptying into genital chamber, with four or five convolutions before expanding to bulbs; neck of bulbs slightly recurved, remainder geniculate submedially and postmedially, and enlarged apically.

BODY LENGTH.—3.9 to 9.2 mm.

WING LENGTH.—4.1 to 10.1 mm.

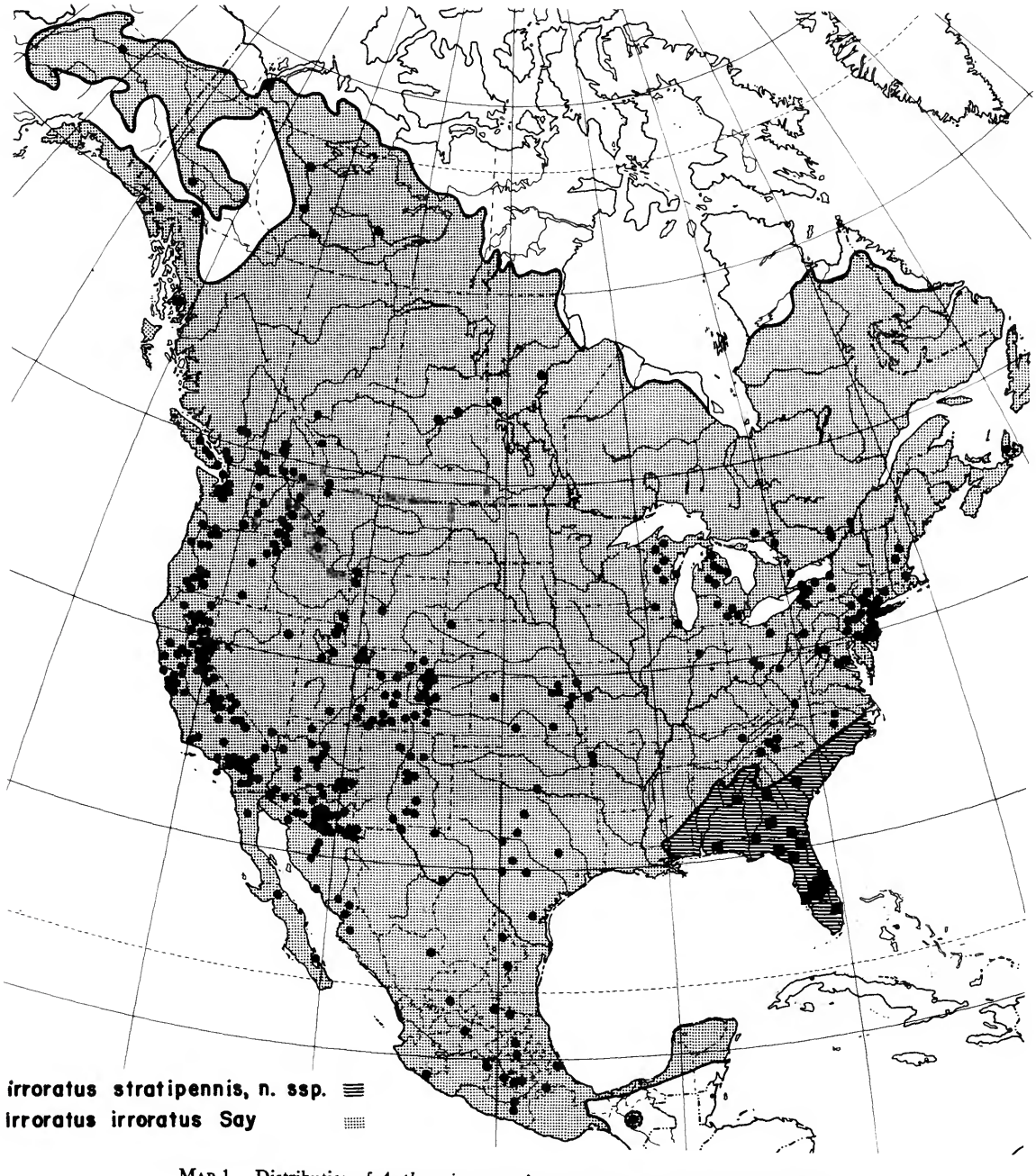
DISTRIBUTION.—*Anthrax irroratus irroratus* occurs in forested areas throughout North America except in southern Mexico, Central America, and Florida and the coastal plain in southeastern United States. It is allopatric to *irroratus striatipennis* in the last area (Map 1).

TYPES.—*Anthrax irroratus irroratus* was described by Say (1823) from material collected in the Rocky Mountains. The specimen or specimens have since been destroyed. The types of *Anthrax irrorata* Macquart (1840) were not mentioned by Painter and Painter (1962). Macquart's species may be synonymous with *irroratus striatipennis* since his specimens were from Carolina and Georgia, but the name is a primary homonym of *irroratus* Say.

BIOLOGY.—This species seems to be a nonspecific parasite of a variety of hymenopterous insects nesting in logs, banks, and open, flat areas. Females often are observed ovipositing in openings of tunnels in stumps and logs and are sometimes attracted to the collector, flipping eggs at dark spots on clothing.

Townsend (1893) described the pupal skin of *A. irroratus irroratus* (as *Argyramoeba oedipus* (Fabricius) from a specimen reared from a species of *Odynerus* (Hymenoptera: Vespidae) taken in Colorado. Davidson (1894) reared this species from the nest of a small bee "made 6 inches deep in adobe soil." Baker (1895) recorded *A. irroratus irroratus* as a parasite of several species of *Odynerus;* Brooks (1952) described and figured the pupa reared from *Megachile nivalis* Friese (Hymenoptera: Megachilidae); and Hall (1954) reared it from a "Hymenopteran nesting in an old anobiid burrow in a log." Recently, Krombein (1967) recorded this species as a parasite of *Megachile gentilis* Cresson, *Dianthidium heterulkei fraternum* Timberlake, *Ashmediella bucconis denticulata* (Cresson) (Hymenoptera: Megachilidae), and *Hylaeus asininus* (Cockerell and Casad) (Hymenoptera: Colletidae), as well as an unidentified vespid wasp.

In collections studied by the author there are specimens reared from *Megachile nivalis* Friese, *M. rotundata* (Fabricius), M. sp., *Osmia rostrata* Sandh., and *Osmia clarescens* Ckll. (Hymenoptera: Megachilidae); *Anthophora* sp. (Hymenoptera: Apidae); *Odynerus* sp. and *Pseudomasaris coquilletti* Rohwer (Hymenoptera: Vespidae); and *Sceliphron* sp. (Hymenoptera: Sphecidae). Others were reared from "*Tapoxylon albitarsi,*" "solitary wasp cocoon" and "from mud wasp in cocoon of moth."



MAP 1.—Distribution of *Anthrax irroratus irroratus and A. irroratus striatipennis.*

DISCUSSION.—*Anthrax irroratus irroratus* and *irroratus striatipennis* differ from other species in the *oedipus* subgroup in having the second antennal segment lenticular rather than saucer shaped with the apical margin produced as a sharp flange. Specimens from southwestern United States and Mexico also are usually smaller than those of *cintalpa,* have the wings more lightly infuscated, and have oblanceolate and obovate rather than linear and lanceolate scales on the sides of the second abdominal tergum. Characters separating *irroratus irroratus* from *irroratus striatipennis* are discussed under the latter.

Anthrax irroratus irroratus is an extremely variable taxon. Specimens from western United States have less heavily pigmented wings and lighter pile and scales than those from eastern United States. There is an even cline across Canada, however, indicating that the two populations are consubspecific, although the two extremes are quite different. Specimens from Mexico also vary in degree of pigmentation of the wings and extent of dark scales. Darkest specimens are from wetter areas while the lightest specimens are from drier areas, which may indicate that differences in color are due to climatic factors.

Anthrax irroratus striatipennis, new subspecies

Argyramoeba oedipus.—Johnson, 1895, p. 325.—Kertész, 1909, p. 66 [part] [not Fabricius, 1805; misidentification].
Spongostylum oedipus.—Johnson, 1913, p. 55 [*Spogostylum*] [not Fabricius, 1805; misidentification].

MALE.—Head with black setae, and black and white scales. Second antennal segment lenticular, not produced as sharp flange apically (Figure 16; Plate 1*k*).

Mesonotum and scutellum with sparse black setae; scales black and white, curly along margins. Pile on prosternum and propleuron black, on anterior portion of mesonotum, dorsal part of mesopleuron, and anterodorsal part of pteropleuron mixed black and white; postalar tuft of pile black with few white hairs. Mesopleuron and sternopleuron with sparse black and white scales. Scales on coxae black and white.

Cells C and Sc of wing (Plate 1*d*) with alternating hyaline and pigmented areas; remainder of wing pigmented with dark brown, transverse striae, most dense and coalesced from basal cells out to bases of cells R_{2+3}, R_5, and $2M_2$, and in broad preapical band. Basal section of vein Cu_1 two-fifths as long as entire vein.

Scales on fore and middle femora mixed black and white; on hind femur black; middle femur without a bristle above anteroventral row.

Scales on hind margin of first abdominal tergum black medially, white laterally; scales on discs of remaining terga black anteriorly, white submedially and laterally on hind margins, white scales more extensive posteriorly. Lateral margins of first tergum with white pile intermixed with black setae and few brown hairs; remaining terga with lanceolate-truncate and ovate-truncate black scales, and black setae. Venter with sparse black setae and linear black scales, few linear white scales present on first sternum.

FEMALE.—Propleuron with some white hairs; scales on mesopleuron white. Pile on lateral margins of first abdominal tergum light yellow.

VARIATION.—The prosternal pile may be partially white. The scales on the coxae and pleurae may be entirely black. The number of white scales on the fore and middle femora varies; a few white scales may be present on the posterior femur. The basal part of vein Cu_1 varies from two-fifths to one-third the length of the entire vein. The pile on the lateral margins of the first tergum varies from yellow to white.

MALE GENITALIA.—Similar to *irroratus irroratus* Say.

FEMALE GENITALIA (Figure 39).—Similar to *irroratus irroratus.* Tenth tergum with 15 spines apically on each side. Lateral lobe of dorsal part of sclerite on each side of gonopore acute. Spermathecae less strongly geniculate subapically.

BODY LENGTH.—7.4 to 9.8 mm.

WING LENGTH.—8.1 to 11.2 mm.

DISTRIBUTION.—*Anthrax irroratus striatipennis* occurs in Florida and the coastal plain of southeastern United States as far west as Alabama and as far north as South Carolina. It is allopatric to *irroratus irroratus* (Map 1).

HOLOTYPE.—♂, Billy's Island, Okefenokee Swamp, Georgia, VI–1912 (Cornell U. Lot. 482, Sub. 148).

ALLOTYPE.—Same data as holotype (in copula).

PARATYPES.—Alabama: *Lee Co.,* ♂, ♀, Auburn, VII–9–1917 (J. Bequaert).

Florida: *Alachua Co.,* ♂, Gainesville, VI–4–1958 (J. W. Perry) (in light trap); ♀, VI–19–1961 (H. A. Denmark) (in black light trap). *Brevard Co.,* ♀, Titusville, IV–25–1923 (F. 4676). *Duval Co.,* ♂, Jacksonville (Mrs. A. T. Slosson); ♀, Jacksonville, VIII–24–1958 (Dave Ribble). *Highlands Co.,* ♂, ♀, Highlands Hammock St. Pk., III–31–1956 (H. V. Weems, Jr.); ♀, Archbold B. Sta., Lake Placid,

III–28–1957 (H. E. Evans). *Orange Co.*, ♂, Gotha, III–96 (W. M. Wheeler). *Osceola Co.*, ♀, Osceola National Forest, VII–1–1961 (A. and H. Dietrich) (ocean pond camp). *Palm Beach Co.*, ♂, Lake Worth (Mrs. A. T. Slosson) (Acc. 26226). *Santa Rosa Co.*, ♀, VIII–15–1956 (F. W. Mead). *Suwannee Co.*, 2♀, Branford, VII–31–1930 (R. H. Beamer). ♀, "W. Park," IV–14–1939.

Georgia: *Decatur Co.*, ♂, Spring Creek, VII–16–29–1912 (Cornell U. Lot 482, Sub. 148). *Tift Co.*, ♀, Tifton, VI–13–1896 (C. W. Johnson). *Screven Co.*, ♀, VII–12–1946 (A. K. Wyatt). 2♀, Billy's Island, Okefenokee Swamp, VI–1912 (Cornell U. Lot 482, Sub. 148). 2♂, "Georgia" (Osten Sacken).

South Carolina: *Aiken Co.*, ♂, Aiken, VI–12–1957 (J. R. Vockeroth).

Other material examined.—Florida: *Pinellas Co.*, ♂, Gulfport, III–3–1925 (F. M. Gaige). *Orange Co.*, ♀, Gotha, III–1896 (W. M. Wheeler).

Georgia: *Bibb Co.*, ♂, Macon, VI–3–1923 (F. W. Walker). ♀, "Prattsburg," VII–25–1930 (L. D. Tuthill); ♂, "Georgia" (Osten Sacken).

Types.—The holotype and allotype are deposited in the Cornell University collection. Paratypes may be found in the collections of the author, R. H. Painter, Cornell University, the Museum of Comparative Zoology, the Canadian National Collection, the American Museum of Natural History, the United States National Museum, the University of Kansas, the University of Michigan, and the Florida State Plant Board.

Discussion.—*Anthrax irroratus striatipennis* usually may be separated from *irroratus irroratus* by the dense pattern of transverse striae on the wing. Specimens of *irroratus* usually have the wing pattern less dense with most of the independent spots rounded. In some specimens of *irroratus* from eastern United States the spots may be elongated, in which case the absence of white scales on the anterior parts of abdominal sterna two through four and the larger size of *striatipennis* will serve to separate the subspecies. The differences between *irroratus* and other species are noted under the nominate subspecies.

Anthrax cintalpa Cole

Argyramoeba oedipus.—Osten Sacken, 1877, p. 243 [part].—Osten Sacken, 1878, p. 90.—Osten Sacken, 1886, p. 102 [part].—Coquillett, 1894, p. 95 [part].—Kertész, 1909, p. 66 [part] [not Fabricius, 1805; misidentification].

Anthrax oedipus.—Edwards, 1930, p. 173 [part] [not Fabricius, 1805; misidentification].

Anthrax cintalpa Cole, 1957, p. 200.—Painter and Painter, 1965, p. 431.

Male.—Head with fine black setae and black and white lanceolate scales, sometimes with a few brown scales. Basal antennal segments brown to red orange; second segment short, saucer shaped, apical margin produced as sharp flange (Figure 14; Plate 1*l*).

Mesonotum and scutellum with linear or lanceolate, black and white scales; often with some brown scales, especially in anterior patch on disc of scutellum. Scales on mesopleuron, sternopleuron, and anterior half of pteropleuron black, brown, white, or mixed. Pile on prosternum, propleuron, and anterior margin of mesonotum black, white, or mixed, often some brown hairs present. Postalar tuft of pile black, often with some white hairs and rarely entirely white. Scales on coxae white, or mixed black and white.

Cells C and Sc of wing (Plate 1*e*), with alternating pigmented and hyaline areas. Remainder of wings with numerous irregular dark brown spots, sometimes coalesced into preapical, submedial, and basal transverse bands, sometimes largely discrete. Discrete spots mostly rounded, few elongated transversely. Basal part of vein Cu_1 one-fifth to one-third as long as entire vein. Spur at basal angle of vein R_4 very rarely connected with vein R_{2+3} forming a sectoral crossvein.

Femora usually black, occasionally reddish brown; tibiae black to reddish yellow. Scales on femora lanceolate and ovate-truncate, usually black anteriorly and white posteriorly. Middle femur without a bristle anteriorly above anteroventral row (Figure 36).

Lateral margins of first abdominal tergum with white pile and few black setae; second tergum with black pile, setae, and erect, lanceolate- and/or oblanceolate-truncate scales laterally; lateral margins of remaining terga with black setae and scales anteriorly, and white or golden-brown scales posteriorly, especially on posterior terga. Posterior margin of first tergum with white scales laterally and black scales medially; discs of remaining terga with linear black scales anteriorly, sometimes with a few golden-brown or white scales; posterior margins with obovate-truncate white scales in submedial and sublateral patches, patches sometimes coalesced on two and five, sometimes reduced or absent on four, and expanded over six and seven. Venter of abdomen with sparse black setae and linear scales, predominantly black in specimens from southern Mexico, predominantly white in specimens from United States.

Female.—Similar to male.

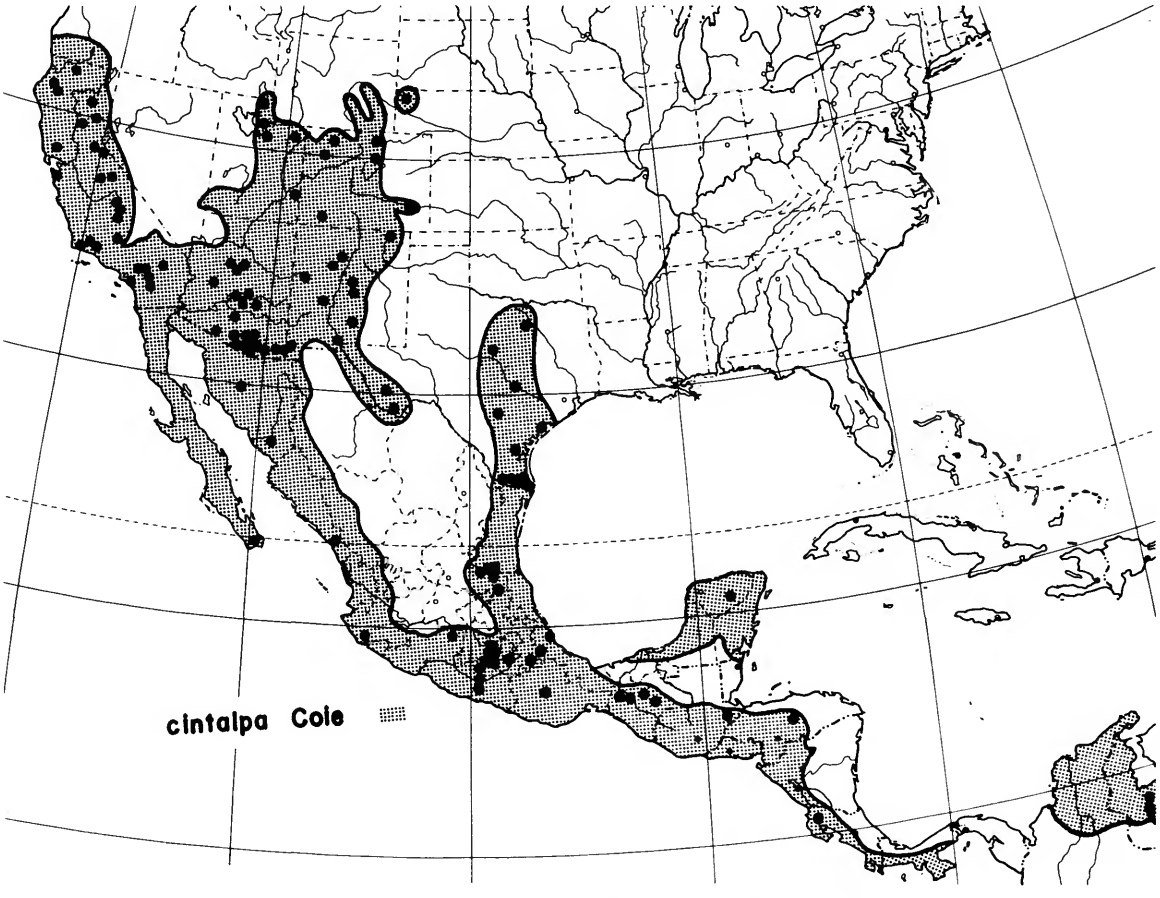
MALE GENITALIA (Figure 8).—Apical part of gonocoxites about three times longer than basal part; distal segment of gonostylus about three times as long as wide. Apex of epiphallus with sharp dorsal flange extending ventrally as sharp carina, a serrate process present above apex of aedeagus. Apex of aedeagus not flared, gonopore ventral. Epandrium rounded apically in dorsal view; cercus projecting apically beyond epandrium.

FEMALE GENITALIA (Figure 47).—Tenth tergum with nine spines apically on each side; ventral extensions at base broadened at right angle apically. Apical part of sclerite on each side of gonopore twisted, lateral lobe arising mesally, narrow, acute apically; ventral extension narrow, slightly acuminate and curved mesally. Ducts of spermathecae united into medial tube before emptying into genital chamber; ducts with six or seven convolutions before expanding to bulbs; bulbs S-shaped basally, widest postmedially, sharply constricted to nipple-like apices.

BODY LENGTH.—6.2 to 10.6 mm.

WING LENGTH.—6.2 to 10.8 mm.

DISTRIBUTION.—*Anthrax cintalpa* occurs in forested areas from southwestern United States through Mexico and Central America into Venezuela (Map 2). The distribution probably is limited on the south by the Amazonian rain forest in Venezuela and by the Andes Mountains in Colombia. In the United States it is limited by the Great Plains and eastern deciduous forests. The northern limit is approximately at the 41st parallel except for a population in northwestern Nebraska.



MAP 2.—Distribution of *Anthrax cintalpa*.

369-673 O—70——2

TYPES.—*Anthrax cintalpa* was described from four specimens collected at Francia, 8 mi. NE of Cintalpa, Chiapas, Mexico, by R. C. Bechtel and E. I. Schlinger. The types are in the University of California (Berkeley) collection. The paratypes have been studied by the author.

BIOLOGY.—Cole (1957) stated that the type specimens of *A. cintalpa* were reared from the nests of *Melitoma euglossoides* Lepeletier and Serville (Hymenoptera: Apidae). Other specimens have been reared from *Megachile chilopsidis, M. concinna,* and *Dianthidium* sp. (Hymenoptera: Megachilidae). This species has been collected in several localities in Mexico by the author, always along steep embankments.

DISCUSSION.—*Anthrax cintalpa* differs from *A. irroratus* in having a saucer shaped rather than lenticular second antennal segment and in lacking oblanceolate and obovate scales on the sides of the second abdominal tergum. *Anthrax oedipus* and *peruvianus* differ from *cintalpa* by having a distinctive bristle or bristles on the anterior side of the middle femur above the anteroventral row; also, *cintalpa* usually has the postalar tuft of pile black or mixed black and white, whereas in Mexican and Central American specimens of *oedipus* it is white.

Anthrax oedipus oedipus Fabricius

Anthrax oedipus Fabricius, 1805, p. 123.—Osten Sacken, 1858, p. 41 [part].—Curran, 1927, p. 85.—Edwards, 1930, p. 173 [part].—Stuardo Ortiz, 1946, p. 93.—Wolcott, 1951, p. 450.—Painter and Painter, 1962, p. 78.

Argyramoeba oedipus.—Lynch Arribálzaga, 1879?.—Wulp, 1882, p. 85.—Osten Sacken, 1886, p. 102 [part].— Williston, 1901, p. 275.—Kertész, 1909, p. 66 [part].

Spongostylum oedipus.—Aldrich, 1905, p. 223 [part] [*Spogostylum.*]

Anthrax irroratus.—Painter, 1930, p. 794.—Wolcott, 1951, p. 450 [not Say, 1823].

Exoprosopa punctata Macquart, 1850, p. 108.

Anthrax punctum Walker, 1850, p. 253.

Anthrax aequa Walker, 1852, p. 192.

Argyramoeba aequa.—Kertész, 1909, p. 59.

Argyramoeba caloptera Schiner, 1868, p. 121.—Kertész, 1909, p. 62.

MALE.—Head with black setae and mixed black, white and sometimes brown, lanceolate scales. Antennae black or with first two segments reddish; second segment short, with apical edge produced as sharp flange (Figure 16).

Mesonotum and scutellum with sparse black setae, and black, white and sometimes brown, linear and lanceolate scales, curly along margins; scutellum usually with a spot of brown scales medially on anterior side. Mesopleuron, sternopleuron, and pteropleuron with white or yellowish-white pile, black or mixed black and yellow setae, and white or mixed brown and white scales; scales on coxae white. Prosternum, propleuron, and anterior margin of mesonotum with white or yellowish-white pile, often with some black hairs; postalar tuft of pile white, rarely with few black hairs.

Cells C and Sc of wing (Plate 1*g*) with alternating hyaline and pigmented areas; remainder of wing pigmented with brown spots, most dense and more or less coalesced from the basal cells out of bases of cells R_{2+3}, R_5, $2M_2$, and Cu_1, and in band from apex of vein Sc to apices of veins M_2 and Cu_1; basal band usually broken midway on vein Cu_2, apical band usually broken on m crossvein and often on vein M_2; specimens from Mexico with posterior spots much reduced. Spur at basal angle of vein R_4 not connected with vein R_{2+3} to form a sectoral crossvein. Basal segment of vein Cu_1 one-fourth to two-fifths as long as entire vein.

Femora with scales usually predominantly black anteriorly and predominantly white posteriorly; middle femur with distinctive bristle or group of bristles on anterior side about three-fifths of way to apex above anteroventral row (Figure 37).

Pile on sides of first abdominal tergum white or yellowish white, few black setae present posteriorly; posterior margin with white scales laterally and black scales medially. Sides of terga two through five with dense black pile and linear black scales; sides of posterior terga with black setae and obovate-truncate white scales. Discs of terga with black scales anteriorly and white scales submedially and laterally on posterior margins, expanded on third segment, reduced on fourth, and expanding over most of terga six and seven; few brown scales sometimes intermixed with white. Sterna with sparse black setae and sparse linear scales, predominantly white anteriorly and mixed black and white posteriorly, sometimes with a few brown scales.

FEMALE.—Similar to male.

MALE GENITALIA (Figure 13).—Apical part of gonocoxites about 2.5 times longer than basal part; distal segment of gonostylus about 3 times longer than wide. Apex of epiphallus with sharp dorsal flange apically, without medial process above aedeagus. Apex of aedeagus flared, gonopore posteroventral, entire laterally. Epandrium rounded apically in dorsal view; cercus projecting apically beyond epandrium.

FEMALE GENITALIA (Figure 49).—Tenth tergum with 10 spines apically on each side; ventral extensions at base slightly expanded and bluntly rounded apically. Dorsal part of sclerite on each side of gonopore bluntly rounded and slightly produced apically toward meson; ventral extension narrow and parallel sided, slightly curved mesally. Ducts of spermathecae uniting into common tube before emptying into genital chamber; ducts with two convolutions before expanding to bulbs; neck of bulbs recurved, remainder straight, broadest medially and slightly constricted before lightly sclerotized apex.

WING LENGTH.—5.8 to 9.5 mm.

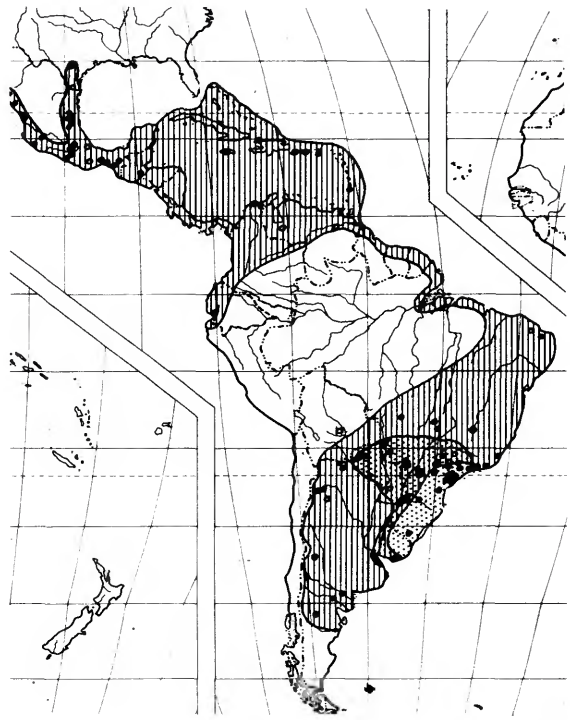
BODY LENGTH.—5.8 to 10.4 mm.

DISTRIBUTION.—*Anthrax oedipus oedipus* occurs throughout South America except in the Amazon Basin and the Andes Mountains, and in southern Brazil where it is replaced by *oedipus aquilus*. It probably occurs throughout the West Indies, Central America, and southern Mexico, ranging northward along the Pacific coast to Sinaloa and along the Gulf coast into south-central Texas (Map 3).

TYPES.—The type-specimens (two males) of *A. oedipus* Fabricius are in the Copenhagen Museum. Painter and Painter (1962) state that one male is preserved in excellent condition; the other is headless and badly rubbed. The better preserved specimen was designated lectotype. The photograph and redescription of the lectotype leave little doubt as to the identity of this species. The type-locality is the West Indies where only *oedipus oedipus* occurs of the species in the *oedipus* subgroup.

Painter and Painter (unpublished notes) state that there are four specimens listed as *Exoprosopa punctata* Macquart (1849) in the Bigot collection in the British Museum. The first carries the label "*Exoprosopa punctata* Macq., 4 supp." (Macquart's label); the second carries the label "*A. punctata. Exoprosopa id.* Macq., Ost. Sacken., Amer. Merid."; the third specimen is labeled "B. Ayres"; and the fourth has no label. Painter and Painter considered the second, if any, specimen to be the type. It is badly covered with fungus and lacks the right wing, but their notes and wing photograph indicate that it is a typical specimen of *oedipus oedipus*. The type-locality is "Amer. Mer."

According to Painter and Painter (unpublished notes), the type of *Anthrax aequa* Walker (1852) is in the British Museum. It carries the labels "One of Walker's types so named. E. A. W.," "Brasil, Mrs. Noel" and the green type label (without a name on the back).



oedipus oedipus Fabricius ||||
oedipus aquilus, n. ssp. ⁘

MAP 3.—Distribution of *Anthrax oedipus oedipus* and *A. oedipus aquilus*.

The type is now headless, lacks all but one leg, has the vesture rubbed off one side of the abdomen, has the left wing glued on, and has the body and wings dirty. The description and photographs of the type made by Painter and Painter indicate that this species is a synonym of *oedipus oedipus*.

The type of *Argyramoeba caloptera* Schiner (1868) was found and marked by Painter and Painter in the Vienna Museum. According to their notes, it is a male, quite well preserved except that its head is covered with fungus obscuring the antennae, and only one middle leg and one foreleg remain. The type carries the labels "Lindig 1864 Venezuela," "Calopterus alte sammlung" and "Argyramoeba calopterus Schin." The photographs and redescription of the type indicate that the species is a synonym of *oedipus oedipus*.

The type of *Anthrax punctum* Walker (1849) was not found in any European museum visited by Painter and Painter. The description leaves little doubt, how-

ever, that the species is a synonym of *oedipus oedipus*. The type-locality is "Brasil."

BIOLOGY.—The only reared specimens in collections seen by the author emerged from cells of *Odynerus guadelupensis* Sauss. at St. Vincent, B.W.I. Specimens of this species have been collected by the author in Paraná and Rio Grande do Norte, Brazil, and Guerrero, Tamaulipas, and San Luis Potosí, Mexico, along paths through forested areas and around stumps and sandy paths in drier areas. Two specimens were observed ovipositing on a stump at São Martinho, Paraná, Brazil.

DISCUSSION.—*Anthrax oedipus* may be distinguished from all other species in the *oedipus* subgroup except *peruvianus* by the presence of a postmedial bristle on the anterior side of the middle femur above the anteroventral row. Characters separating *oedipus oedipus* from *oedipus aquilus* and *peruvianus* are discussed under those taxa.

Anthrax oedipus aquilus, new subspecies

Argyramoeba oedipus.—Kertész, 1909, p. 66 (part).
Anthrax oedipus.—Edwards, 1930, p. 173 (part).

MALE.—Scales on head black and white. Basal antennal segments black; second segment saucer shaped, apical margin produced as sharp flange.

Mesonotum and scutellum with black setae and black and white scales; scutellum with golden-brown scales in large medial patch on anterior half. Mesopleuron, pteropleuron, and sternopleuron with black setae and mixed black and white scales, some black and white pile on mesopleuron. Pile on prosternum, propleuron, and anterior margin of mesonotum mixed black and white; postalar tuft of pile black. Coxae with black setae and white scales.

Cells C and Sc of wing (Plate 1*h*) with alternating pigmented and hyaline areas. Remainder of wings with numerous irregular dark brown spots, mostly coalesced into preapical, submedial, and basal transverse bands. Submedial and basal bands not distinctly separated; preapical band extending unbroken from tip of vein Sc to tip of vein Cu_1; submedial band continuous in cell Cu_1 on basal half of vein Cu_2. Spur at basal angle of cell R_4 connected with vein R_{2+3} to form a complete sectoral crossvein. Basal part of vein Cu_1 about one-fourth as long as entire vein.

Femora black, tibiae reddish brown. Scales on fore and middle femora mixed black and white posteriorly, black anteriorly; scales on hind femur entirely black. Middle femur with distinctive bristle three-fifths of way to apex on anterior side in addition to anteroventral row.

First abdominal tergum with white pile and few black setae laterally; sides of second tergum with black setae and dense black pile and scales; third, fourth, and fifth terga with black setae, hairs, and scales laterally, some obovate-truncate white scales posteriorly on two and four; sixth and seventh terga with white scales laterally. Posterior margin of first tergum with white scales laterally, and black scales medially and among white scales; discs of remaining terga with black scales anteriorly and white scales along posterior margins in submedial and sublateral patches, white scales united medially on five and spreading over discs on six and seven. Venter with black setae, and linear and lanceolate scales, white on first sternum, anteriorly on second sternum and laterally on posterior margins of second and following sterna, black elsewhere.

FEMALE.—Similar to male. Postalar tuft of pile with few golden-brown and white hairs.

VARIATION.—The basal antennal segments vary from black to reddish brown. The spur at the basal angle of cell R_4 may not be connected to vein R_{2+3} in one wing or rarely in both wings; the subapical band of spots may be broken on the m crossvein; the submedial band is rarely broken on vein Cu_2. The femora may be reddish brown or black, the tibiae vary from reddish brown to yellow. White scales on venter of abdomen may be slightly more extensive than in the type, but usually are not more numerous than the black scales on segments three through seven.

MALE GENITALIA.—Similar to *oedipus oedipus*. Distal lobe of gonostylus sometimes less than three times as long as wide.

FEMALE GENITALIA.—Similar to *oedipus oedipus*.

BODY LENGTH.—6.3 to 11.0 mm.

WING LENGTH.—6.7 to 9.7 mm.

DISTRIBUTION.—*Anthrax oedipus aquilus* occurs in the plateau of southern Brazil and adjacent areas as far north as southern Minas Gerais and west into Paraguay (Map 3). A specimen from Buenos Aires may indicate that this subspecies has a more extensive southern distribution than shown on the map. Specimens collected by the author were found in rather dense forested areas.

HOLOTYPE.—♂, Jacarezinho, Paraná, Brazil, II–14–1961 (N. Marston–9).

ALLOTYPE.—♀, Bagé, Rio Grande do Sul, Brazil, III–1–1961 (N. Marston–1).

PARATYPES.—Argentina: *Missiones,* Parambi, I-II-1950 (J. H. Jibson).

Brazil: *Santa Catarina,* ♀, Nova Teutonia, II-2-1938 (F. Plaumann); ♀, Nova Teutonia, XII-1955 (F. Plaumann); ♀, Nova Teutonia, I-14-1956 (F. Plaumann); ♀, Nova Teutonia, X-1956 (F. Plaumann); 2♀, X-31-XII-7-1956 (F. Plaumann); 2♀, Nova Teutonia, I-27-30-1957 (F. Plaumann); ♀, Nova Teutonia, IX-22-1957 (F. Plaumann); 2♀, Nova Teutonia, I-21-II-2-1959 (F. Plaumann); ♀, Nova Teutonia, XII-4-1959 (F. Plaumann). *São Paulo,* ♀, Barueri, IV-19-1955 (K. Lenko); ♂, 2♀, Barueri, III-31-V-24-1957 (K. Lenko); ♀, Embu, IX-1949 (F. Lane); ♂, 3♀, Faz. do Bonito, Serra da Bocaina, S. Jose do Barreiro, I-1-II-10-1960 (Vulcano); ♂, Itú, III-22-1961 (N. Marston-6); ♂, Osasco, IX-1951 (M. A. V. A.); ♂, São Paulo, Cid. Jardim, I-1945 (Barretto); 4♂, ♀, São Paulo, Ypiranga, IV-2-17-1936 (Lange de Morretas); ♂, São Paulo, Ypiranga, I-1940 (Carrera); ♂, "São Paulo" (Barbiellini); ♂, Ste. André, V-1937 (R. Spitz).

Forty-six additional specimens have been examined from these localities:

Argentina: Buenos Aires, Buenos Aires.

Brazil: Cidade Azul, Minas Gerais; Curitiba, Paraná; Cauna and Nova Teutonia, Santa Catarina; Barueri, Campos do Jordão, Cantaricira, Guarujá, Monte Alegres, Piedade and São Paulo, São Paulo.

Paraguay: Col. Independéncia and Molinesque.

TYPES.—The holotype and allotype are in the U.S. National Museum collection. Paratypes are deposited in the collections of the author, R. H. Painter, the University of California, the Canadian National Collection, the American Museum of Natural History, the Departmento de Zoologia, Secretaria de Agricultura, São Paulo, Brazil, the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil, and the Instituto Miguel Lillo, Universidád de Tucumán, Tucumán, Argentina.

DISCUSSION.—The margin between the ranges of *A. oedipus aquilus* and *oedipus oedipus* seems poorly defined. Intermediates have been studied from these localities: Jacarezinho, Paraná; Nova Teutonia, Santa Catarina; Jataí, Goiás; Porto Cabral, São Paulo; and Caceres, Bodoquena, and Corumbá, Mato Grosso. Since it appears that *oedipus* is adapted to arid areas, whereas *aquilus* occurs in areas with denser vegetation and higher rainfall, the broad range of intermediates could be accounted for by recent restriction of the range of *aquilus* and expansion of the range of *oedipus* due to progressively drier climate in south-central Brazil and Paraguay.

Anthrax oedipus aquilus differs from the nominate subspecies in having a complete sectoral crossvein and in having the postalar tuft of pile black. There are also several other less reliable differences between the subspecies. The wings usually are more heavily infuscated in *aquilus* than in *oedipus* with the submedial band of spots continuous to the apex of vein 2A in the former, whereas it usually is broken on vein Cu_2 in the latter. Also, *aquilus* generally has fewer white scales, especially ventrally on the posterior femur, ventrally on the abdomen and posteriorly on the mesonotum.

Differences between *A. oedipus* and other species in the *oedipus* subgroup are discussed under the nominate subspecies.

Anthrax peruvianus, new species

MALE.—Head with black setae, and black, white, and yellow scales. Fringe of pile on posterior margin of occiput black with light tips. Antennae black; second segment short, with apical margin produced as sharp flange.

Disc of mesonotum with yellow, white, and black scales; scutellum with lanceolate golden-brown scales medially. Scales on mesopleuron, pteropleuron, and sternopleuron white. Pile on prosternum white, on propleuron and anterior margin of mesonotum white with some black hairs and setae intermixed; postalar tuft of pile white. Scales on coxae white.

Cell C of wing (Plate 1*f*) with alternating hyaline and pigmented areas; cell Sc with alternating pigmented and subhyaline areas. Remainder of wings pigmented with brown spots, most dense and mostly coalesced in medial and preapical bands. Spur at basal angle of cell R_4 not connected with vein R_{2+3} to form a sectoral crossvein. Basal section of vein Cu_1 about one-fourth as long as entire vein.

Femora with white and yellowish-white scales, a few brown scales on anterior surfaces of fore and middle pairs; middle femur with distinctive bristle anteriorly above anteroventral row.

Sides of first abdominal tergum with dense white pile, with few black setae posteriorly; posterior margin with yellowish-white scales. Sides of second tergum with black pile and lanceolate scales anteriorly, and with some yellow hairs and lanceolate scales posteriorly; sides of third through sixth terga with black hairs and scales anteriorly and yellowish-white hairs and

scales posteriorly; sides of seventh tergum with white scales. Discs of second and following terga with linear black and brown scales anteriorly; posterior margins with white scales submedially and laterally, black scales decreasing and white scales increasing in number posteriorly. Sterna with yellow setae and rather dense linear and lanceolate white scales.

FEMALE.—Fore and middle femora with patches of brown scales anteriorly.

VARIATION.—The pile on the thorax and sides of the first abdominal tergum varies from white to yellowish white with some brown hairs sometimes present. The lateral margins of terga two and four may or may not have tufts of white scales posteriorly. The scales on the anterior surfaces of the femora may be predominantly yellowish white or brown. The pigmented areas in the cell Sc of the wing may be well or poorly defined. The spots on the wing vary from light brown to dark brown; they may or may not be coalesced into medial and preapical bands. The spur at the basal angle of vein R_4 may connect to vein R_{2+3} to form a sectoral crossvein.

MALE GENITALIA (Figure 10).—Apical part of gonocoxites about twice as long as basal part; distal segment of gonostylus about 1.5 times longer than wide. Apex of epiphallus with a sharp dorsal flange, without medial process above aedeagus. Apex of aedeagus flared, with distinct lateral and ventral emarginations. Epandrium rounded apically in dorsal view; cercus projecting apically beyond epandrium.

FEMALE GENITALIA (Figure 46).—Tenth tergum with 12 spines apically on each side; ventral extensions at base sharply rounded apically. Dorsal part of sclerite on each side of gonopore broad laterally with sharp dorsal angle and rounded ventral angle, produced as narrow dorsal lobe toward meson; ventral extension narrow, parallel sided and slightly curved toward meson. Ducts of spermathecae united before emptying into genital chamber, with two convolutions before expanding to bulbs; neck of bulbs recurved, remainder broadest medially and slightly constricted before lightly sclerotized apex.

BODY LENGTH.—8.1 to 9.6 mm.

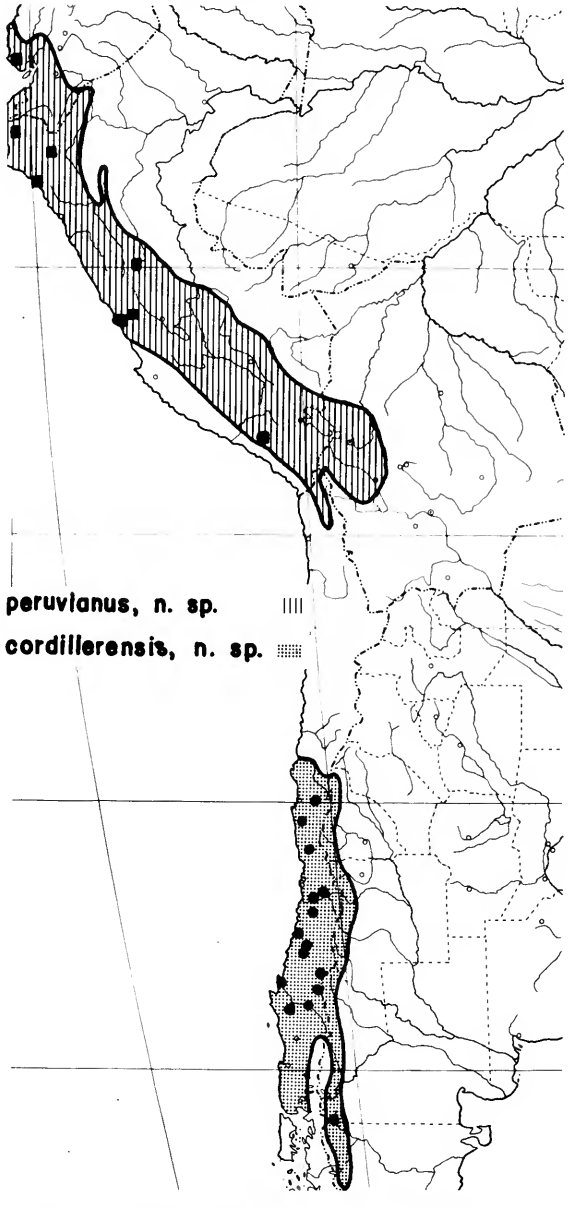
WING LENGTH.—7.6 to 9.2 mm.

DISTRIBUTION.—*Anthrax peruvianus* is known from only a few localities in Peru (Map 4).

HOLOTYPE.—♂, Pachacamac, Lima, Peru, IX-1-1964 (R. H. Painter).

ALLOTYPE.—♀, same data as holotype.

PARATYPES—Peru: *Arequipa*, ♂, IV-10-1938. *Guayas*, ♂, 8 mi. S Manglar Alte, I-31-1955 (E. I. Schlinger and E. S. Ross). *Huanuco*, ♀, IV-6-1940, 1900 m (Weyrauch) (W. K. W., 3480-C). *Lambayeque*, ♀, Chiclayo, XII-12-1930; ♀, 42 mi. E Olmos, I-18-1955 (E. I. Schlinger and E. S. Ross). *Lima*, ♀, Chaclacayo, 750 m (E. Escomel); 2♂, ♀, Chosica,



MAP 4.—Distribution of *Anthrax peruvianus* and *A. cordillerensis*.

XI-5, XII-13-14-1964 (P. Hocking); 3♀, Lima, I-1-1939 (Weyrauch) (W. K. W., 3480); ♀, Lima (Soukeep); 11♂, ♀, Matucana, X-31-1964, 8000 feet (R. H. Painter); 2♂, "W. K. W., 3480." *Piura,* ♀, Piura. ♀, "La Areha," VII-14-1944 (Berry).

TYPES.—The holotype and allotype are in the collection of R. H. Painter. Paratypes may be found in the collections of the author, Prof. Wolfgang Weyrauch, R. H. Painter, the American Museum of Natural History, the Museum of Comparative Zoology, the California Academy of Sciences and the U.S. National Museum.

DISCUSSION.—*Anthrax peruvianus* is most closely related to *oedipus*. The male genitalia are quite similar, but *peruvianus* has the apex of the aedeagus shallowly three-lobed while in *oedipus* it is entire and rounded. Externally, *peruvianus* has patches of golden-brown scales on the abdominal terga and has few, if any, black scales on the third, fourth, and fifth sterna. It usually has a tuft of brown and white scales posteriorly on the lateral margins of the second tergum. *Anthrax oedipus* is usually darker, lacking large patches of brown scales on the abdominal terga and having numerous black scales on the third, fourth, and fifth sterna. There are no brown or white scales posteriorly on the lateral margins of the second tergum.

Anthrax peruvianus sometimes has pigmented areas in the cell Sc poorly defined and separated by subhyaline areas, although it does not appear to be closely related to the Chilean species, so it may be keyed through both choices of couplet 2. It may be readily separated from all species, except *oedipus,* in the *oedipus* subgroup, by the bristle or bristles anteriorly above the anteroventral row on the middle femur.

Anthrax cordillerensis, new species

Anthrax oedipus.—Edwards, 1930, p. 173 [part] [not Fabricius, 1805].

MALE.—Scales on head black, and white or yellowish white. Basal antennal segments black; second segment saucer shaped, apical margin produced as sharp flange.

Scales on mesonotum black and white, few golden-brown ones intermixed. Scutellum with white and black scales, few golden-brown scales present around white patches. Pile on dorsal half of mesopleuron and anterodorsal part of pteropleuron white, few golden-brown hairs present. Scales on lower half of mesopleuron, anteroventral part of pteropleuron, and sternopleuron mostly white, few black and golden-brown scales present. Pile on prosternum, propleuron, and anterior margin of mesonotum mixed black and white, few brown hairs present on the propleuron. Postalar tuft of pile black. Scales on coxae brown and white.

Cell C of wing (Plate 1*j*) with alternating pigmented and hyaline areas; cell Sc mostly subhyaline, without well-defined pigmented areas. Remainder of wing with numerous rounded brown spots not coalesced into transverse bands. Sectoral crossvein incomplete. Basal part of vein Cu_1 two-fifths as long as entire vein.

Femora black, tibiae orange. Fore and middle femora with black and white scales; hind femur with black scales. Middle femur without bristle anteriorly above anteroventral row.

Pile on sides of first abdominal tergum white, few black hairs and setae present posteriorly. Sides of second tergum with black pile and erect, linear scales; sides of terga three to six with black setae and oblanceolate and oblanceolate-truncate scales, black anteriorly, white posteriorly, white scales most extensive on three; seventh tergum with oblanceolate-truncate white scales. Discs of remaining terga with linear black scales anteriorly and oblanceolate or oblanceolate-truncate white scales submedially and laterally along margins, white scales expanding over discs on posterior terga. Scales on venter long and white on first sternum and lateral margins of posterior sterna, short and black elsewhere.

FEMALE.—Similar to male. Basal antennal segments orange. Posterior femur with white scales ventrally.

VARIATION.—There may be a few white scales ventrally on the posterior femora. The basal antennal segments may be red orange or black. Cell C of the wing may be entirely infuscated or subhyaline. The spots on the wing may be fewer in some specimens, and the basal and anterior part of the wing may be more heavily infuscated than in the types.

MALE GENITALIA (Figure 12).—Apical part of gonocoxites about 2.75 times longer than basal part; distal segment of gonostylus about twice as long as wide. Dorsal part of apex of epiphallus atrophied, remainder trilobed apically; medial carina arched dorsally, lateral carina produced basad of medial carina. Epandrium acuminate apically in dorsal view, extending past cercus.

FEMALE GENITALIA (Figure 43).—Tenth tergum with nine spines apically on each side; ventral extensions from base broadened and rounded apically.

Sclerite on each side of gonopore rounded dorsally, produced above lateral lobe; lateral lobe not tapering, bluntly rounded distally; ventral extensions tapering, sharply curved mesad distally. Ducts of spermathecae emptying together into genital chamber, with two convolutions before expanding to bulbs; neck of bulbs curved at right angle, remainder straight, broadest medially, and tapering to each end.

BODY LENGTH.—7.2 to 11.7 mm.

WING LENGTH.—6.9 to 10.5 mm.

DISTRIBUTION.—Apparently *A. cordillerensis* inhabits a rather small area along the east and west sides of the Andes Mountains in central Chile and western Argentina (Map 4).

HOLOTYPE.—♂, Las Cruces, Cord. Parral, Linares, Chile, XI-11/25-1960 (Luis Peña).

ALLOTYPE.—♀, same data as holotype.

PARATYPES.—Argentina: *Rio Negro,* ♀, El Bolsón, I-1955.

Chile: *Bio Bio,* ♂, ♀, El Abanico, XII-31-1950 (Ross and Michelbacher). *Concepción,* ♂, Concepción, XII-1926 (R. and E. Shannon). *Coquimbo,* ♂, 5 mi. N Illapel, XI-30-1950 (Ross and Michelbacher); 2♂, 5 mi. N Laguna Dam, XII-6-1950 (Ross and Michelbacher); ♀, 20 mi. SW of Ovalle, XII-12-1950 (Ross and Michelbacher); ♀, 12 mi. E Rivadavia, XII-4-1950 (Ross and Michelbacher). *Linares,* ♂, Fundo Malcho, XI-1956 (Luis Peña); 5♂, Fundo Malcho, I-1957 (Luis Peña); ♂, Fundo Malcho, XII-1957 (Luis Peña); ♂, Fundo Malcho, I-1958 (Luis Peña); ♂, Fundo Malcho, II-1958 (Luis Peña); 2♂, Las Cruces, Cord. Parral, XI-11/25-1960 (Luis Peña). *Malleco,* ♂, Angol, XII-4-1945; ♂, Angol, XII-4-1946; 3♂, Angol, XI-6-1947 (D. S. Bullock); 2♂, Angol, XII-8-1956; ♂, Angol, XI-15-1957 (W. Salinas). *Maule,* ♂, Constitucion (P. Garulla; 2♂, ♀, "Constitucion." *Nuble,* 2♂, 50 km E of San Carlos, XII-28-1950 (Ross and Michelbacher). *Santiago,* ♀, Las Mercedes, II-1937 (P. Flamino Ruíz); ♂, ♀, Qta. Normal, Santiago, XII-11-1950 (E. Zomasa); ♀, Santiago, "06"; ♀, Pichinahuel, Cord. Nahuelabuta, I-10/20-1959 (Luis Peña). ♂, "Pua," II-4-1958 (G. Dorman). ♂, "Chile," I-12-1959 (T. Schmidt and D. Lepin).

Additional specimens have been seen from the following localities in Chile: Fundo Malcho, Linares Prov.; El Peumo, O'Higgins Prov.; Laja, Nuble Prov.; "Estero Leira"; "C. Chile" and "Chile."

TYPES.—The holotype and allotype are in the collection of the U.S. National Museum. Paratypes may be found in the collections of the author, the Museum of Comparative Zoology, the Instituto Oswaldo Cruz in Rio de Janeiro, the University of California, Michigan State University, the U.S. National Museum, the California Academy of Sciences, Jack C. Hall, and R. H. Painter.

DISCUSSION.—*Anthrax cordillerensis* differs from *inordinatus* in lacking a complete sectoral crossvein, in having the femora black rather than orange, and in lacking patches of golden-brown scales on the abdomen. It may be distinguished from *peruvianus* by the lack of bristles on the anterior side of the middle femur above the anteroventral row and by the lack of white scales on the posterior side of the posterior femur. It differs from other species in the *oedipus* subgroup in lacking well-defined spots in the subcostal cell of the wing.

A few specimens of *cordillerensis* have the cell C mostly or entirely subhyaline as in the *pluto* subgroup. These specimens usually also have the wings somewhat darker than usual and have cell 2M entirely infuscated.

Anthrax inordinatus Rondani

Anthrax vicinus Blanchard, 1852, p. 381.—Kértesz, 1909, p. 57.—Philipi, 1865, p. 663 [preoccupied Marquart, 1846].
Anthrax inordinatus Rondani, 1863, p. 64.—Kértesz, 1909, p. 42.
Argyramoeba poecilophora Schiner, 1868, p. 121.—Kértesz, 1909, p. 66.
Anthrax oedipus.—Edwards, 1930, p. 173 [part] [not Fabricius, 1805].

MALE.—Scales on head mostly white to brown, some black scales present. Basal antennal segments yellow; second segment saucer shaped, with the apical margin produced as a sharp flange.

Discs of mesonotum and scutellum with black, brown, and white scales. Scales on mesopleuron, pteropleuron, and sternopleuron golden brown; pile on mesopleuron brown and white. Prosternum with mixed brown and white pile; pile on propleuron and anterior margin of mesonotum brown and white. Postalar tuft of pile black with some brown or white scales basally. Scales on coxae white or mixed brown and white.

Cell C of wing (Plate 1*i*) with alternating brown and hyaline areas; cell Sc subhyaline, without distinct spots. Remainder of wings with large, rounded spots, more or less coalesced into preapical, medial and basal bands; few independent spots. Spur at basal angle of cell R_4 usually connected to vein R_{2+3} to form a sectoral

crossvein. Bases of cells narrowly margined with subhyaline. Basal part of vein Cu_1 one-fourth to one-third length of vein.

Femora, tibiae, and basal tarsal segments orange. Femora with black, brown, and white scales; middle femur rarely with bristle on anterior side above anteroventral row.

Sides of first abdominal tergum with dense, white or yellowish-white pile and few black setae; posterior margin fringed with golden-brown or mixed golden-brown and white scales. Sides of posterior terga with black setae and black scales anteriorly, with white scales posteriorly, black scales less extensive on posterior terga. Discs of second and following terga with bands of golden-brown and black scales; posterior margins with submedial and lateral patches of white and golden-brown scales, expanding on posterior terga. Venter of abdomen with golden-brown and white scales, sometimes with black scales medially on posterior sterna.

FEMALE.—Similar to male.

MALE GENITALIA (Figure 11).—Apical part of gonocoxites about 2.5 times longer than basal part; distal segment of gonostylus about as long as wide. Apex of epiphallus atrophied; aedeagus trilobed apically; medial carina flattened dorsally, lateral carina not produced basad of medial carina. Epandrium acuminate apically in dorsal view, extending past the cercus.

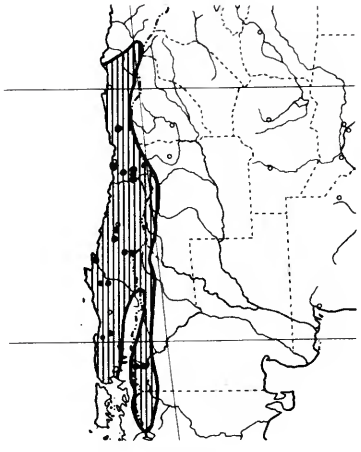
FEMALE GENITALIA (Figure 48)—Tenth tergum with seven spines apically on each side; ventral extensions from base tapering apically. Apex of sclerite on each side of gonopore broadly produced above lateral lobe, tapering to broadly rounded apex; lateral lobe small, truncate apically; ventral extension broad on upper two-thirds, tapering and strongly curving mesad on lower third. Spermathecal ducts emptying together into genital chamber; ducts with two convolutions before expanding the bulbs; neck of bulbs curved; remainder slightly sinuous, narrow basally, widest postmedially, and narrowing abruptly to apex.

BODY LENGTH.—7.6 to 10.8 mm.

WING LENGTH.—7.4 to 9.7 mm.

DISTRIBUTION.—*Anthrax inordinatus* occurs on both sides of the Andes Mountains in central Chile and western Argentina (Map 5). Its distribution seems to be the same as that of *cordillerensis*.

TYPES.—Painter and Painter (unpublished notes) found the type male of *Anthrax inordinatus* Rondani (1863) in the Museo dell' Instituto di Zoologia dell' Universitá di Napoli in Naples, Italy. The type is headless, has a thin film of fungus, and has one wing broken, but is otherwise in good condition. It carries the labels "M°. Zoo.° N°, 11125" and *Anthrax inornatus* (sic) Rond. Chili."



MAP 5.—Distribution of *Anthrax inordinatus* Rondani.

Painter and Painter found the male and female types of *Argyramoeba poecilophora* Schiner in the Naturhistorisches Museum in Vienna, Austria. The male was in good condition, although a little dusty, and was designated the lectotype. The female had a *Villa* head glued onto it. The lectotype carried the labels "Chile Novara Reise" and "*poecilophora* Alta Sammlung," but no type label. Photographs of the lectotype show it to be a typical specimen of *inordinatus* Rondani.

DISCUSSION.—*Anthrax inordinatus* differs from *cordillerensis* in having a complete sectoral crossvein, in having the femora orange instead of black, and in having large patches of golden-brown scales on the abdomen. *Anthrax inordinatus* is superficially quite similar to *peruvianus*, although the latter is more closely related structurally to *oedipus*. *Anthrax peruvianus* may be distinguished readily by the presence of a distinctive bristle or bristles on the anterior surface of the middle femur above the anteroventral row, and by the absence of a complete sectoral crossvein. *Anthrax inordinatus* may be distinguished from the other members of the *oedipus* subgroup by the absence of well-defined pigmented areas in the cell Sc of the wing.

Anthrax pluto pluto Wiedemann

Anthrax pluto Wiedemann, 1828, p. 261.—Osten Sacken, 1858, p. 41 [part].—Painter and Painter, 1962, p. 80.—Painter and Painter, 1965, p. 432.

Argyramoeba pluto.—Osten Sacken, 1877, p. 244 [part].—Osten Sacken, 1878, p. 90 [part].—Coquillett, 1894, p. 95 [part].—Kertész, 1909, p. 66 [part].

Spongostylum pluto.—Aldrich, 1905, p. 223 [part] [*Spogostylum*].

MALE.—Scales on head black and white. Basal antennal segments black; second segment saucer shaped, produced as a sharp flange apically.

Scales on mesonotum and scutellum mostly black; some white scales present, especially along margins. Pile on mesopleuron and pteropleuron mixed black, white, and brown; scales on pleura black and white. Prosternum, propleuron, and anterior margin of mesonotum with mixed black and white pile; sometimes with a few brown hairs, especially on humeral calli; postalar tuft of pile mixed black and white. Scales on coxae black and white.

Cells C and Sc of wing (Plate 2*e–f*) entirely infuscated or with small subhyaline spots before and after humeral crossvein in costal cell. Cells 1M, 2M, and R entirely infuscated except for a subhyaline or hyaline area submedially in cell R and sometimes a subhyaline area medially or postmedially in cell 2M. Bases of cells 1A and 2A completely infuscated or with small subhyaline areas basally. Spots at bases of cells R_{2+3}, R_5, $2M_2$, and Cu_1 broadly coalesced with basal infuscated area; basal third of cell $1M_2$ infuscated. Discrete or coalesced spots present at bases of cells R_4 and M_1, at apices of veins R_{2+3}, M_2, Cu_1, and Cu_2, at the medial angle of vein R_4 and m crossvein, subapically on vein R_{2+3}, and below tip of vein R_1; broad spot extending from vein R_1 to vein M_{1+2} halfway between bases of cells R_{2+3} and R_4.

Fore and middle femora with black scales anteriorly and white or mixed black and white scales posteriorly; scales on hind femur black; a few white scales sometimes posteriorly.

Sides of first abdominal tergum with white pile; some black hairs usually present posteriorly; posterior margin with white scales laterally and black scales medially. Lateral margins of terga two through five with black pile, linear and lanceolate scales, and black setae, few obovate white scales present posteriorly on third; sixth and seventh terga with white scales present submedially on posterior margins of two through five, laterally on five and sublaterally on two and three; terga six and seven with black scales medially and white scales laterally. Sterna one, two, and three with threadlike, mostly white scales; black scales sometimes present on two and three; sterna four through seven with black or mixed black and white scales.

FEMALE.—Similar to male.

MALE GENITALIA (Figure 34).—Apical part of gonocoxites narrow and slightly tapering in lateral view, apex acute. Distal segment of gonostylus rectangular basally with broad apical hook, ventral margin slightly undulating. Apex of epiphallus curled upward and outward dorsally and laterally, with short ventrolateral extensions; basal recurved process sharp, relatively large. Tip of aedeagus not flared, gonopore distoventral; base of aedeagus large, bulbous, tapering gradually to junction with ventral bands; lateral and medial apodemes large in relation to base of aedeagus.

FEMALE GENITALIA (Figure 41).—Tenth tergum with 11 spines apically on each side; ventral extensions at base broadly rounded apically. Apical part of sclerite on each side of apices of spermathecal ducts narrow and clavate laterally, sharply produced dorsally toward the meson; ventral extension very long and narrow, parallel sides and slightly curved mesad. Ducts of spermathecae with one convolution before expanding to bulbs; neck of bulbs broadly and evenly recurved; remainder slightly curved and broadest postmedially.

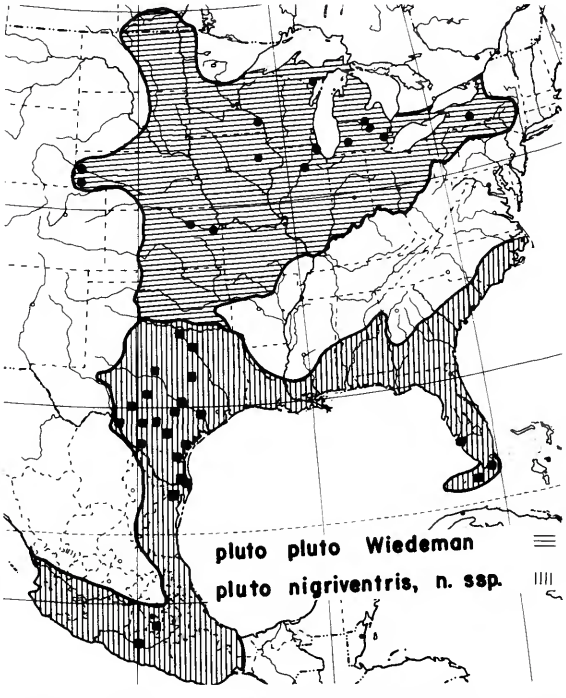
BODY LENGTH.—7.4 to 12.0 mm.

WING LENGTH.—6.7 to 11.0 mm.

DISTRIBUTION.—The small number of specimens available of *pluto pluto* indicates that it occurs from the Appalachian Mountains to the Great Plains as far north as Michigan and probably as far south as Oklahoma and Tennessee (Map 6). Wiedemann designated "Kentucky" as the type-locality. *Anthrax pluto pluto* is allopatric to *pluto nigriventris* on the south.

TYPES.—Painter and Painter (1962) stated that the three females comprising the type series in the Vienna Museum are well preserved. The largest female, carrying the labels "*Pluto* det. Wiedemann," "Col. Winthem" and "Pluto Wied. Kentucky," was designated lectotype.

DISCUSSION.—*Anthrax pluto pluto* differs from *pluto nigriventris* in having numerous white scales on the abdominal sterna and in having the pile on the lower half of the lateral margin of the first abdominal tergum entirely white or with only a few black hairs posteriorly. It may be distinguished from *stellans* by the absence of golden-brown scales on the lower margin of the hind femur and the abdominal sterna.



MAP 6.—Distribution of *Anthrax pluto pluto* and *A. pluto nigriventris.*

Anthrax pluto nigriventris, new subspecies

Anthrax pluto.—Osten Sacken, 1858, p. 41 [part].—Brimley, 1938, p. 341.

Argyramoeba pluto.—Osten Sacken, 1877, p. 244 [part].—Osten Sacken, 1878, p. 90 [part].—Wulp, 1881, p. 85.—Coquillett, 1894, p. 95 [part].—Kertész, 1909, p. 66 [part].

Spongostylum pluto.—Aldrich, 1905, p. 223 [part] [*Spogostylum*].—Johnson, 1913, p. 55 [*Spogostylum*].

MALE.—Scales on head black and white. Antennae black; second segment saucer shaped, produced apically as a sharp flange.

Scales on mesonotum mostly black; few white ones on disc, and brown and white ones along margins. Scales on scutellum black and white. Pile on mesopleuron and pteropleuron mixed black, brown, and white. Scales on pleura sparse, black. Prosternum, propleuron, and anterior margin of mesonotum with mixed black, brown, and white pile, black predominating on former, white predominating on latter; postalar tuft of pile mixed black and white. Scales on coxae black and white.

Cells C and Sc of wing (Plate 2*g*) infuscated. Base of wing out to r-m crossvein and base of cell Cu_1 mostly infuscated, hyaline and subhyaline areas present postmedially in cell 2M, submedially and subapically in cell R, and basally in cell R_{2+3}; submedial spot on vein 2A large, poorly defined from base; spot at base of cell $2M_2$ narrowly connected to basal pigmented area. Independent spots present at apices of vein R_{2+3}, M_2, Cu_1, and Cu_2, in cell R below base of vein R_1, on vein R_{2+3} below apex of vein R_1, at medial angle and base of vein R_4; at base of cell M_1 and at medial angle of m crossvein; broad spot present midway between r-m crossvein and base of Cell R_4 extending from vein M_{1+2} to vein R_1.

Femora red orange apically, black basally; tibiae red orange. Scales on femora and tibiae black.

Pile on sides of first abdominal tergum white dorsally, black and white ventrally; posterior margin with few white scales laterally. Sides of terga two through five with dense black pile and lanceolate scales; sides of sixth tergum with black pile and black and white scales; sides of seventh tergum with white scales. Discs of terga two through six with black scales, small patches of white scales present on posterior margins submedially on two through five, sublaterally on two, three, and five, and laterally on six; seventh tergum with black scales medially and white scales laterally. Scales on venter mostly black, few threadlike white scales present on first sternum.

FEMALE.—Similar to male. No brown hairs on anterior collar. Mesopleuron with numerous threadlike white scales ventrally on mesopleuron. Cell 2M of wing (Plate 2*h*) with medial longitudinal subhyaline area only; subhyaline areas basally in cells 1A and 2A reduced. Fore and middle femora with some white scales posteroventrally.

VARIATION.—The scales on the mesopleuron and pteropleuron vary from entirely white to entirely black; a few white scales may occur on the sternopleuron. The relative amounts of black, white, and brown pile on the prosternum, propleuron, and the anterior margin of the mesonotum vary and the brown pile may sometimes be absent. Cell 2M of the wings may be entirely infuscated or have a small hyaline area postmedially; cells 1A and 2A may or may not have subhyaline areas at their bases. There may be a small subhyaline area in the costal cell after the humeral crossvein. The size of the spots and the degree of coalescense in the outer part of the wing is variable, the females being darker. The scales on the fore and middle femora may be entirely black or a few may be white. The ventral half of the lateral margins of the first abdominal tergum may

be entirely black pilose or a few white hairs may be intermixed. A few white scales may occur on the anterior sterna.

MALE GENITALIA (Figure 35).—Similar to *pluto pluto*. Distal segment of gonostylus broader basally, dorsobasal angle shorter and less acute. Apex of epiphallus produced apically above, ventrolateral parts curving basally at a sharp angle; apex of aedeagus curved downward, gonopore ventral.

FEMALE GENITALIA.—Similar to *pluto pluto*. Tenth tergum with 10 spines on each side.

BODY LENGTH. —6.7 to 12.2 mm.

WING LENGTH.—6.3 to 11.3 mm.

DISTRIBUTION.—*Anthrax pluto nigriventris* has been collected in south Florida, central Texas, and eastern and south-central Mexico. It probably also occurs along the Gulf coast between Texas and Florida and possibly north along the Atlantic coast (Map 6).

HOLOTYPE.—♂, Brownwood, Brown Co., Texas, VI–7 (R. H. Painter).

ALLOTYPE.—♀, Brownwood, Brown Co., Texas, VI–6–1936 (R. H. Painter).

PARATYPES.—Texas: *Brown Co.*, ♀, Brownwood, IX–12–1922 (R. H. Painter); ♂, Brownwood, VIII–11–1932 (R. H. Painter); ♂, Brownwood, VI–7 (R. H. Painter). *Cameron Co.*, ♀, Brownsville, June; ♀, Brownsville, July; ♂, 8 mi. E Brownsville, VII–18–1962 (N. Marston–4). *Colorado Co.*, ♂, VI–7–1922 (Mrs. Grace Wiley). *Comal Co.*, ♀, Spring Branch, VII–4–1946 (S. Camras). *Dallas Co.*, ♂, Dallas, VII–30–1939 (R. H. Painter). *Dimmit Co.*, ♂, Carrizo Springs, VII–7–1938 (Jean Russell). *Edwards Co.*, ♂, Rock Springs, VI–14–1962 (R. R. Grable). *Hidalgo Co.*, ♀, 25 mi. SW Harlingen, IV–10–1945 (D. E. Hardy and V. L. Wooley). *Karnes Co.*, ♀, Hobson, VIII–14–1931. *Kleberg Co.*, ♂, Kingsville, VI–7–1921; ♀, Kingsville, VI–18–1921 (F. M. Hull); ♂, Kingsville, VII–2–1921 (F. M. Hull); ♀, Kingsville, VII–17–1921. *McLennan Co.*, ♀, Waco (Belfrage). *Mason Co.*, ♂, Mason, VIII–24–1926 (R. H. Painter). *San Patricio Co.*, ♂, ♀, IV–1–1938 (W. Benedict). *Travis Co.*, ♀, Austin, VII–15–1923 (R. H. Painter); ♂, Austin, V–31–1958 (C. S. Lin); ♂, summer, 1931 (J. K. G. Silvey). *Uvalde Co.*, ♀, Sabinal, V–1910 (F. C. Pratt); ♀, Sabinal, VII–6–1936 (M. B. Jackson); ♀, Uvalde, VIII–28–1933 (A. W. Linquist). *Val Verde Co.*, ♂, Del Rio, VII–16/17–1946 (H. E. Evans).

Mexico: *Guerrero*, ♂, 33 mi. S Iguala, 1450 feet, VII–5–1954 (J. G. Chillcott). *Morelos*, ♀, 11 mi. E Cuernavaca, Lobo Canyon, 3900 feet, VIII–15–1962 (R. H. and E. M. Painter). *Tamaulipas*, ♂, 15 mi. S Matamoras, VI–6–1961 (Univ. Kans. Exped.).

Eleven additional specimens have been examined from Brown, Cameron, Kleberg, Medina, Montague, and Val Verde counties in Texas; Lee and Monroe counties in Florida; and "Georgia" (Osten Sacken).

TYPES.—The holotype and allotype are in the collection of R. H. Painter. Paratypes may be found in the collections of the author, R. H. Painter, Cornell University, the University of California, the University of Kansas, the University of Michigan, the U.S. National Museum, Iowa State University, the Florida State Plant Board, and the Chicago Museum of Natural History.

DISCUSSION.—A specimen from Sanibel Island, Lee County, and another from Key Largo Key, Monroe County, Florida, are tentatively referred to this subspecies. They differ from typical forms in having the infuscation of the wings greatly increased. Cells 1A and 2A are almost completely filled and the spots in the outer part of the wing are completely coalesced except for those at the tips of veins R_{2+3}, R_4, M_1 and at the medial angle of vein R_4. Otherwise the specimens agree with those from Texas.

One specimen from "Georgia" (Osten Sacken) is intermediate between *pluto pluto* and *pluto nigriventris*. It has white scales on the posterior margins of the fore and middle femora and has mixed black and white scales on the abdominal sterna.

Anthrax pluto nigriventris differs from *pluto pluto* in having the scales on abdominal sterna two through seven entirely black or with only a few white ones posterolaterally. It differs from both *pluto pluto* and *atriplex* in having the pile on the lower half of the sides of the first abdominal tergum black rather than white.

Anthrax insulanus, new species

Spongostylum sp., nr. *pluto*.—Wolcott, 1951, p. 450 [*Spogostylum*]

MALE.—Scales on head black, white, and yellow. Basal antennal segments black, second segment saucer shaped, apical margin produced as sharp flange.

Scales on mesonotum mostly black; some white scales present, dense along lateral margins. Scutellum with black and white scales; pile on mesopleuron dense, snowy white; bristles on pleura black and gold. Prosternum, propleuron, and anterior margin of mesono-

tum with mixed black and white pile, black predominating on prosternum; postalar tuft of pile mixed black and white. Scales on coxae mixed black and white.

Cells C and Sc of wing (Plate 2*i*) evenly infuscated with brown except for large hyaline spot after and small one before humeral crossvein in cell C and hyaline spot after humeral crossvein in cell Sc. Remainder of wing with brown, largely coalesced spots. Cell 1M with small hyaline spot apically; cells R and 2M with hyaline spots medially; submedial spot on vein 2A connected with basal infuscation in cell 1A, discrete in cell 2A; spot at base of cell Cu_1 broadly connected with spots at bases of cells R_1, R_{2+3}, and R_5; large elongate spot extending from before apex of vein Sc in cell R_1 to vein M_{1+2}, narrowly connected with spot at base of cell R_4; spots at base of cell M_1, apex of vein Cu_1 and apical angle of m crossvein narrowly connected; independent spots present apically on veins R_{2+3}, R_4, M_2, and Cu_1, at base of cell $2M_2$, at medial angle of vein R_4, below tip of vein R_1 in cell R_1, and on vein R_{2+3} above base of cell R_4.

Scales on femora mostly black; few white scales anteriorly on fore and middle femora.

Sides of first abdominal tergum with dense, snow-white pile; posterior margin with white scales laterally and black scales medially. Sides of terga two through five with dense black pile, linear scales and setae, few white scales posteriorly on third; terga six and seven with white scales, some black pile and scales anteriorly on sixth. Discs of terga two through seven with black scales, posterior margins with white scales submedially and sublaterally on two, sublaterally on three, submedially on four and five, and laterally on six and seven; few white scales submedially on three, and sublaterally on four and five. Scales on venter black except for few threadlike white scales on first sternum and sides of second sternum.

FEMALE.—Similar to male. Wing (Plate 2*j*) with spots somewhat larger and more coalesced; independent spots only at apices of veins R_{2+3}, R_4, Cu_1, at medial angle of vein R_4, and in cell R_1 below tip of vein R_1.

VARIATION.—There is little variation in the specimens examined from the Bahama Islands. The second antennal segment may be black or red and the tibiae vary from reddish yellow to dark red. The size and degree of coalescence of the spots on the wings are variable but are encompassed approximately by the limits of the holotype and allotype.

A series of nine specimens from Haiti exhibit some consistent variations from the typical species. The white pile in front of the base of the wing is more sparse and has black setae intermixed; the scales on the lower part of the thoracic pleura are gold rather than black, and some scales are usually white. The posterior margins of the femora have predominantly gold scales. The infuscation of the wing is similar, but the area distad to the humeral crossvein in cell C is sometimes subhyaline and poorly defined from the infuscated portion. Two specimens from Puerto Rico are intermediate between those from the Bahamas and those from Haiti.

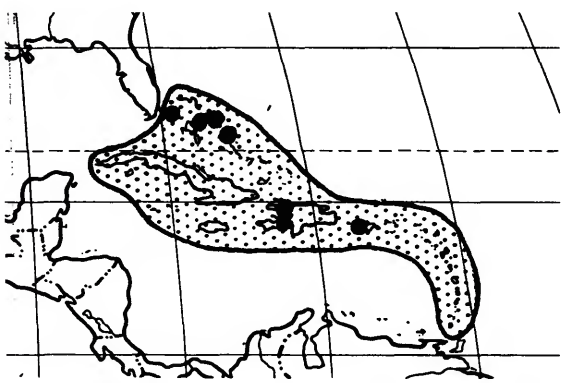
MALE GENITALIA (Figure 33).—Similar to *pluto pluto*. Distal segment of gonostylus shorter, exterior side concave at base.

FEMALE GENITALIA (Figure 44).—Similar to *pluto pluto*. Tenth tergum with eight spines on each side. Sclerite on each side of spermathecal ducts shorter and thicker above; lateral arm not clavate, broadened basally; dorsal process broad, acuminate, and laterally curved. Spermathecal ducts with two convolutions before widening into bulbs.

BODY LENGTHS.—9.6 to 11.8 mm.

WING LENGTH.—8.0 to 10.1 mm.

DISTRIBUTION.—*Anthrax insulanus* probably occurs throughout the West Indies, although specimens have been seen only from Haiti, Puerto Rico, and the Bahama Islands (Map 7).



MAP 7.—Distribution of *Anthrax insulanus*, new species.

HOLOTYPE.—♂, South Bimini Island, Bahamas, British West Indies, VI–1951 (M. Cazier, C. and P. Vaurie).

ALLOTYPE.—♀, South Bimini Island, Bahamas, British West Indies, VII–1951 (C. and P. Vaurie).

PARATYPES.—British West Indies: *Bahamas*, 2♂, East Bimini Island, VI–1951 (P. and C. Vaurie); 4♂,

Eleuthera Island, New Portsmouth (Rock Sound), III–28–1953 (E. B. Hayden and L. Giovannoli); ♂, New Providence Island, 4 mi. SW Nassau, IV–8–1953 (E. B. Hayden and L. Giovannoli); 3♂, South Bimini Island, VI–1951 (M. Cazier, C. and P. Vaurie); 2♂, South Bimini Island, VII–1951 (C. and P. Vaurie); ♂, South Bimini Island, VIII–10/20–1951 (C. and P Vaurie).

Puerto Rico: ♂, *Ensenada,* VII–14/19–1915.

Other material examined.—British West Indies: Bahamas, ♂, ♀, Cat Island, Arthur's Town, VII–VIII–1935 (W. J. Clench); ♂, New Providence Island, 4 mi SW Nassau, III–8–1953 (E. B. Hayden and L. Giovannoli); ♀, South Bimini Island, VI–1951 (Mont Cazier, C. and P. Vaurie); ♀, South Bimini Island, VIII–10/20–1951 (C. and P. Vaurie).

Haiti: ♂, 4♀, Bois Caradeux, VIII–10/11–1934 (E. M. Ducasse); ♀, Port-au-Prince ("Student Collection"); ♀, Port-au-Prince, I–15/23–1922; ♂, Port-au-Prince, III–3–1923 (R. C. Smith); ♀, St. Marc, III–30/IV–2–1922 (C. H. Curran).

Puerto Rico. ♂, Ensenada, VI–14/19–1915 (C. H. Curran); ♂, Mamayes, III–31–1925; ♂, "Monals," VIII–1939 (L. F. Martorell).

Types.—The holotype and allotype are in the collection of the American Museum of Natural History. Paratypes may be found in the collections of the author, R. H. Painter, the American Museum of Natural History, and the Florida State Plant Board.

Discussion.—*Anthrax insulanus* may be separated from other species in the *pluto* subgroup by the absence of brown or black hairs on the upper half of the mesopleuron.

A female from 12 mi. SE of Tololapan, Oaxaca, Mexico, collected by R. H. and E. M. Painter, is very similar to specimens of *insulanus.* It has less white pile on the upper half of the mesopleuron and above the wing, and the wing is slightly darker. If this is a specimen of *insulanus,* the distribution of the species probably includes the Gulf coast of Central and South America, as far north as central Mexico.

Anthrax stellans (Loew)

Argyramoeba stellans Loew, 1869, p. 28 [*Argyromoeba*].—Coquillett, 1894, p. 95.—Kertész, 1909, p. 67.

Spongostylum stellans.—Aldrich, 1905, p. 223 [*Spogostylum*].—Cole and Lovett, 1921, p. 244 [part] [*Spogostylum*].

Anthrax stellans.—Painter and Painter, 1965, p. 432.

Argyramoeba pluto.—Osten Sacken, 1877, p. 244 [part].—Osten Sacken, 1878, p. 90 [part] [not Wiedemann, 1828; misidentification].

Anthrax pluto.—Johnson, 1925, p. 108.—Curran, 1927, p. 85 [not Wiedemann, 1828; misidentification].

Male.—Scales on head black, white, and sometimes brown. Second antennal segment saucer shaped with apical margin produced as sharp flange.

Scales on mesonotum mostly black, few white and brown ones present, especially along margins. Scutellum with white, brown, and black scales. Pile on mesopleuron and pteropleuron black, white, and brown. Scales on pleura white and brown. Prosternum, propleuron, and anterior margin of mesonotum with mixed brown, white, and black pile. Postalar tuft of pile black, few white hairs sometimes present, some white scales basally. Scales on coxae white, few brown ones sometimes present.

Cell C of wing (Plate 2*a*) entirely infuscated or partly subhyaline beyond humeral crossvein; cell Sc infuscated except apex and stigmatic area. Remainder of wing with coalesced spots at bases of cells Cu_1, $1M_2$ and R_1, R_{2+3}, and R_5, R, and 2M, and extending from vein M_{1+2} to vein R_1 midway between bases of cells R_{2+3} and R_4. Isolated spots at bases of cells R_4, M_1, and $2M_2$, below tip of R_1 in cell R_1, apically and subapically on vein R_{2+3}, medially and apically on vein R_4, apically on vein M_2, medially on m crossvein, and apically on vein Cu_2. A large, poorly defined spot medially on vein 2A extending across cell 1A and halfway across cell 2A. Cell 2M hyaline to partly infuscated medially. A small spot often present apically on vein Cu_1.

Fore and middle femora with white scales posteroventrally and black scales anterodorsally, some golden-brown scales present between black and white ones. Hind femur with golden-brown scales ventrally and black scales elsewhere. Sometimes a few white scales basally.

Pile on sides of first abdominal tergum white, few black hairs posteriorly; posterior margin with white scales laterally and black scales medially. Sides of terga two through six with black pile and scales, with some white and brown scales, especially posteriorly; white scales on sides of seventh tergum. Discs of terga two through five with black scales; posterior margins with submedial and sublateral patches of white scales, patches on two and three often enlarged and coalesced, sublateral patches on four and submedial patches of five reduced; some brown scales sometimes mixed with white. Terga six and seven with black scales medially

and white scales laterally. Scales on first sternum threadlike, white; posterior sterna with white scales apically and golden-brown scales preapically and sometimes basally.

FEMALE.—Similar to male. Infuscation of wing (Plate 2*b*) more extensive; cell 2M and apical portion of cell R often entirely infuscated; spots in distal portion of wing larger. White scales more extensive on femora, sometimes occupying as much as one-third of ventral margin of hind pair.

MALE GENITALIA (Figure 30).—Similar to *pluto pluto*. Apex of epiphallus flared; apex of aedeagus enlarged, slightly flared, gonopore apical.

FEMALE GENITALIA—Similar to *seriepunctatus*. Ducts of spermathecae with two convolutions before expanding to bulbs.

BODY LENGTH.—8.5 to 11.5 mm.

WING LENGTH.—7.6 to 10.6 mm.

DISTRIBUTION.—*Anthrax stellans* occurs in coniferous forests in Canada, south along the Coast Range and Sierra Nevada into southern California, in the Rocky Mountains into Colorado and central Utah, and at higher elevations along the Canadian border in northeastern United States (Map 8). It may occur as far north as the extent of the spruce forests in northern Canada.

A series of specimens from Tifton County, Georgia, appear to belong to this species. If so, they are probably a relict population surviving from the last glaciation.

TYPES.—The type, which is in the Museum of Comparative Zoology at Harvard University, is badly rubbed and molded. Contrary to Loew's statement, the type is a female. The type-locality is "Oregon."

DISCUSSION.—*Anthrax stellans* differs from all other species in the *pluto* subgroup in having golden-brown scales ventrally on the hind femur and on the abdominal sterna.

Anthrax seriepunctatus (Osten Sacken)

Argyramoeba seriepunctata Osten Sacken, 1886, p. 103.—Kertész, 1909, p. 67.

Spongostylum seriepunctatum.—Aldrich, 1905, p. 223 [*Spogostylum*].

Anthrax seriepunctatus.—Painter and Painter, 1962, p. 81; 1965, p. 432.

MALE.—Scales on head black and white. Second antennal segment saucer shaped, distal margin produced as sharp flange.

Scales on mesonotum black and white, few gold scales present, especially on margins. Scutellum with white and black scales, few gold scales intermixed with white. Pile on mesopleuron and pteropleuron black and white; scales on pleura threadlike, white. Pile on prosternum, propleuron, and anterior margin of mesonotum mixed black and white, few gold hairs sometimes present; postalar tuft of pile white or mixed black and white. Scales on coxae white.

Cells C and Sc of wing (Plate 2*c*) subhyaline or hyaline. Remainder of wing largely hyaline, isolated spots or clouds at bases of all cells in outer part, on vein R_5 halfway between bases of cells R_{2+3} and R_4, and in cell R below base of cell R_1; sometimes a faint cloud submedially on vein 2A and medially on m crossvein.

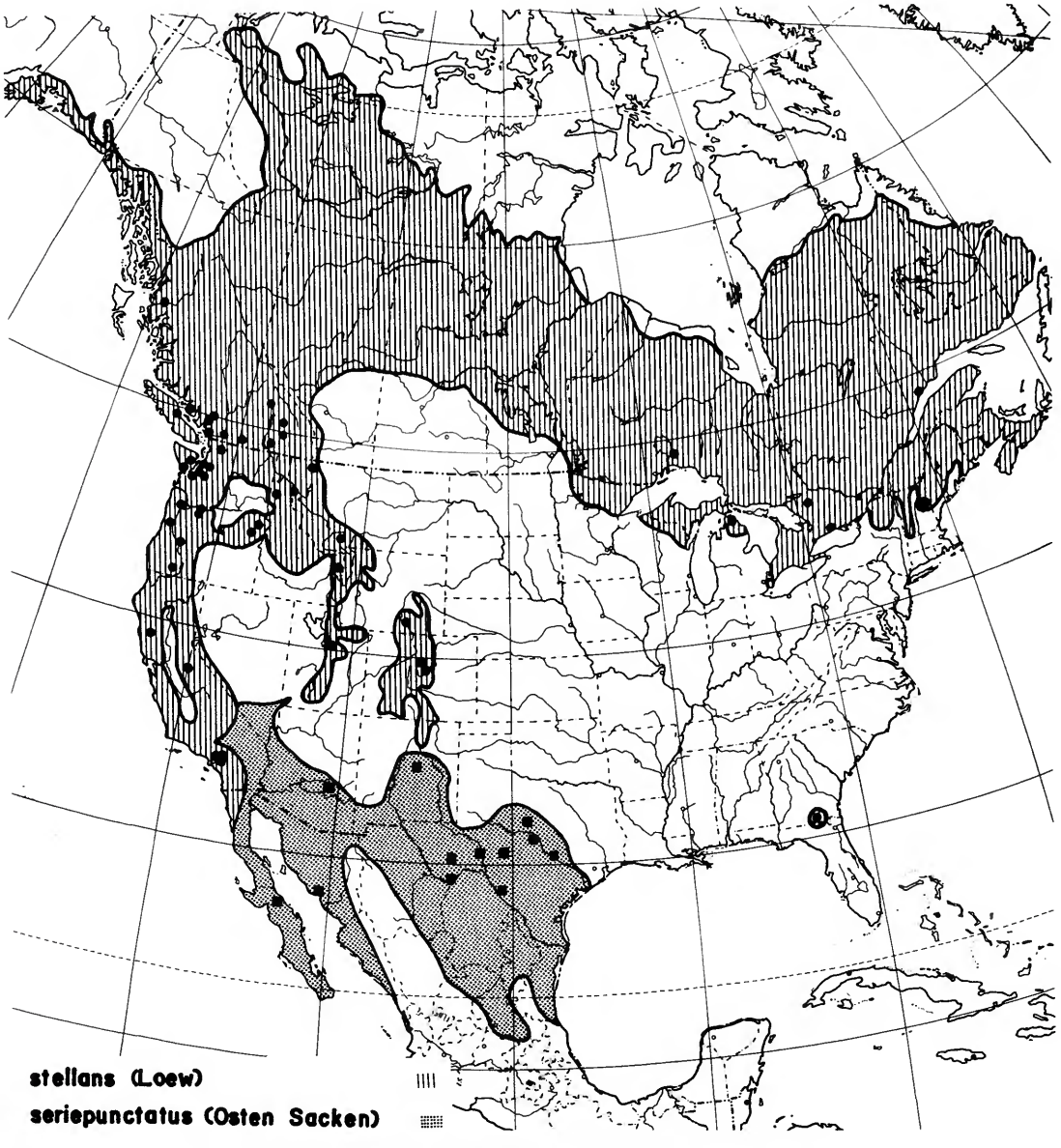
Fore and middle femora with black scales anteriorly, white scales posteriorly; hind femur with black scales anteriorly, mixed black and white scales posteriorly.

Sides of first abdominal tergum with white pile; posterior margin with long, threadlike white scales. Sides of second tergum with black pile, few white scales posteriorly; sides of terga three, four, and five with black pile and scales anteriorly, and white scales posteriorly, white scales sometimes reduced on four; sixth and seventh terga with white scales laterally, sometimes with a few black scales anteriorly on fifth. Discs of terga two through five with black scales anteriorly and linear white scales across posterior margins, few black scales sometimes interrupting white medially on two and three, and submedially on four and five; sixth and seventh terga with white scales laterally and black scales medially. First sternum with sparse linear white scales; second and third sterna with black scales anterolaterally and white scales elsewhere; scales on posterior sterna predominantly black, few white ones along posterior margins.

FEMALE.—Similar to male. White scales on anterior margin of scutellum reduced or replaced by gold scales. Scales on posterior femur often entirely black. Spots on wing (Plate 2*d*), often somewhat larger.

MALE GENITALIA (Figure 28).—Similar to *pluto pluto*. Distal segment of gonostylus short, broad at base. Apex of epiphallus shortened and broadened, ventrolateral parts almost vertical. Apex of aedeagus slightly flared, gonopore apical. Ventral bands swollen dorsally at junction with aedeagus.

FEMALE GENITALIA (Figure 42).—Tenth tergum with nine spines apically on each side; ventral extensions at base sharply pointed apically. Sclerite on each side of gonopore hatchet shaped, lateral extension



MAP 8.—Distribution of *Anthrax stellans* and *A. sereipunctatus*.

broad, dorsal margin angled upward; dorsal extension short, broadly angled, ventral extension narrow, curved mesally. Ducts of spermathecae with three convolutions before expanding to bulbs; bulbs bent before middle, narrow basally, broadened after bend and constricted at apex.

BODY LENGTH.—9.2 to 12.3 mm.

WING LENGTH.—3.0 to 10.3 mm.

DISTRIBUTION.—The few specimens of *seriepunctatus* available indicate that the species occurs in the desert shrub area of the southwestern United States and central and western Mexico, and eastward into the mesquite and oak–hickory areas in central Texas (Map 8).

NEW MATERIAL EXAMINED.—Arizona: *Gila Co.*, ♀, Globe, IX–23–1933 (Parker).

New Mexico: *Torrance Co.*, ♂, VI–24, 7,000 feet (R. H. Painter).

Texas: *Brewster Co.*, ♂, Big Bend National Park, VI–23–1947 (L. D. Beamer); ♀, Big Bend National Park, VII–30–1956 (E. G. Matthews); ♀, Glen Spring, VI–20–1928 (F. M. Gaige); ♀, Marathon, VI–25–1947 (A. C. Michener). *Brown Co.*, ♂, Brownwood, VI–6–1936 (R. H. Painter). *Pecos Co.*, ♂, ♀, Sheffield, VII–5–1917 (J. Bequaert). *San Saba Co.*, ♂, San Saba, VII–23–1921. *Sutton Co.*, ♂, Sonora, V–4–1954 (L. D. Beamer). *Travis Co.*, ♀, Austin, IV–27–1902. *Val Verde Co.*, ♂, 16 mi. SE Del Rio, IV–10–1950 (Beamers, Stephen, Michener. Rozens).

Mexico: *Baja California Sur*, ♀, San Ignacio, IX–29–1941 (Ross and Bohart). *Sonora*, ♀, Guaymas, IV–11–1921 (E. P. Van Duzee).

TYPES.—*Anthrax sereipunctatus* was described by Osten Sacken (1886) from a male and female from northern Sonora and two females from "Tehuacan." Painter and Painter (1962) report that the male and female are in the British Museum and the two females from "Tehuacan" are in the Turin Museum. The male was designated as lectotype. The specimens from Tehuacan are far out of the range postulated for this species. Both Osten Sacken and Painter and Painter indicated that they are similar to the specimens from northern Sonora so they probably are specimens of either *seriepunctatus* or *atriplex*. In either case, an extension of the postulated range of these species down the eastern coast of Mexico would be indicated.

DISCUSSION.—*Anthrax seriepunctatus* differs from *atriplex* in lacking brown or black scales on the thoracic pleura, in having long, narrow white scales predominating on abdominal sterna one through three, and in having linear white scales across the posterior margins of abdominal terga two through five. It differs from other species in the *pluto* subgroup in that cell 2M is completely hyaline except for small spots at the extreme base and apex, and in having at most only a small cloud submedially on vein 2A.

Anthrax atriplex, new species

Argyramoeba pluto.—Osten Sacken, 1886, p. 102 [not Wiedemann, 1828; misidentification].
Anthrax atriplex Marston.—Krombein, 1967, p. 402.

MALE.—Scales on head black and white. Second antennal segment saucer shaped, apical margin produced as a sharp flange.

Scales on mesonotum mostly black, some brown and white ones, especially along lateral margins. Scales on scutellum black and white, few brown scales sometimes present. Pile on mesopleuron and pteropleuron white and brown. Scales on pleura brown and white. Prosternum, propleuron, and anterior margin of mesonotum with mixed black and white pile, some brown hairs on first two. Postalar tuft of pile mixed black and white. Scales on fore coxa brown and white.

Cell Sc of wing (Plate 2*k*) entirely infuscated except for stigmatic area and apex; cell C infuscated before humeral crossvein except for distal hyaline spot, subhyaline to hyaline beyond humeral crossvein. Remainder of wing with spots at bases of cells R_4, M_1, and $2M_2$, coalesced spots at bases of cells R_{2+3} and R_5, Cu_1, $1M_2$ and R_1, and R and 2M; isolated spots in cell R_1, below tip of vein R_1, apically and subapically on vein R_{2+3}, on medial angle of vein R_4, on medial angle of m crossvein, subapically on vein Cu_2, and submedially on vein 2A (extending broadly into both cells 1A and 2A); transverse spot present medially on vein R_{4+5} extending across cell R_{2+3}, and longitudinal spot present postmedially in cell R_1.

Scales on fore and middle femora and tibiae black anteriorly, narrowly white posteriorly. Scales on hind femur and tibia entirely black.

Sides of first abdominal tergum with white pile, with few brown hairs posteriorly; posterior margin with white scales laterally and black scales medially. Sides of terga two through five with black pile and scales; sides of terga six and seven with few black scales and numerous white scales. Discs of terga two through five with black scales except for submedial and larger sublateral patches of lanceolate white scales on posterior margins; spots of white scales reduced laterally on segment four, coalesced medially on segment five; terga six and seven with black scales medially and white scales laterally. Scales on venter black and brown, few white scales present posterolaterally on two, five, six, and seven.

FEMALE.—Similar to male. Brown hairs less numerous on thoracic pleura, absent on prosternum and propleuron. Postalar tuft of pile almost entirely white. Spots on wing (Plate 2*l*) larger; cells C and 2M partially infuscated medially. Some white scales posteriorly on sides of abdominal terga; spots of white scales more extensive on discs of abdominal terga, few gold scales submedially on posterior margins of two and three.

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Scales on first abdominal sternum curly, linear, white; dark scales on remainder of sterna entirely black.

VARIATION.—The color of the linear scales on the posterodorsal part of the sternopleuron varies from white or yellow in the west to brown in the east. The remaining scales vary from white to yellowish white. The postalar tuft of pile varies from entirely white in some specimens from Texas to predominantly black in a few specimens from southern California. The brown hairs on the thoracic pleura are often absent in specimens from the western part of the range. The pigmentation of the wing may be slightly darker or lighter than that described for the types. There may be some yellowish or white scales along the posterior margins of the abdominal sterna, but the scales on the anterior parts of the sterna are always black.

MALE GENITALIA (Figure 31).—Similar to *pluto pluto*. Apex of epiphallus flared outward; apex of aedeagus enlarged, slightly flared, gonopore apical.

FEMALE GENITALIA (Figure 45).—Similar to *pluto pluto*. Tenth tergum with 12 spines on each side. Lateral arm of sclerite on each side of spermathecal ducts broad; ventral arm twisted. Ducts of spermathecae with two convolutions before expansion to bulbs; bulbs broadest postmedially.

BODY LENGTH.—6.9 to 11.0 mm.

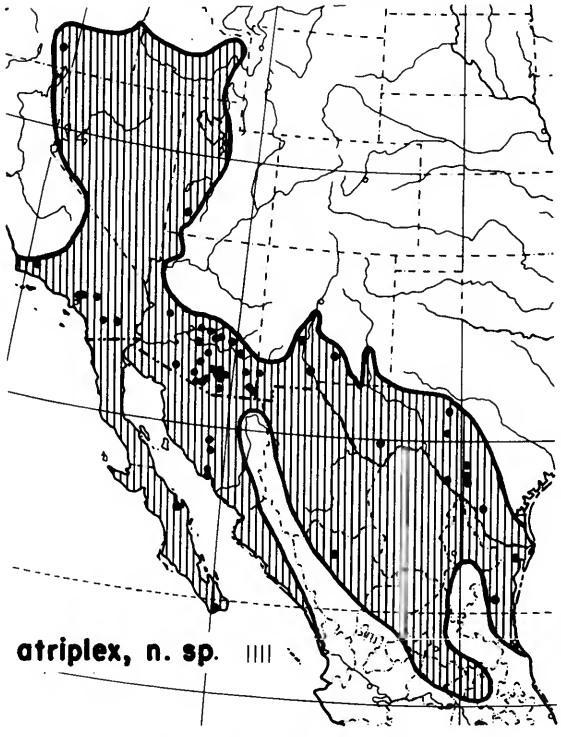
WING LENGTH.—6.1 to 10.8 mm.

DISTRIBUTION.—*Anthrax atriplex* occurs in the desert scrub zone in the southwestern United States from southern Texas to southern California, south into central and western Mexico and north in the Great Basin (Map 9). It is allopatric to *melanopogon*.

HOLOTYPE.—♂, 10 mi. NW Nogales, Santa Cruz Co., Arizona, IV–27–1961, 3600 feet (R. H. and E. M. Painter).

ALLOTYPE.—♀, same data as holotype.

PARATYPES.—Arizona: *Cochise Co.*, Bowie, VI–23–1954 (G. D. Bulter); ♀, 2 mi. NE Portal, V–18–1961 (R. H. and E. M. Painter); ♀, 3 mi. W Rodeo, N. M., VII–9–1956 (H. and A. Howden); ♂, VII–29–1927 (R. H. Beamer). *Gila Co.*, 4♂, 4♀, Globe, VII–27–1932 (R. H. Painter) 2♂, ♀, Globe, V–9–23–1935 (Parker); ♂, Wheatfields, near Globe, VIII–19 (D. K. Duncan); 8♂, Miami, VII–22–1932 (R. H. Beamer); ♂, 2♀, Tonto National Monument, VII–26–1932 (R. H. Painter). *Graham Co.*, ♀, Thatcher, IX–6–1947 (E. J. Taylor). *Pima Co.*, ♂, Baboquivari Mtns., IV–29–1935 (F. H. Parker); 2♂, ♀, Baboquivari Mtns., VII–24–1941 (R. H. Beamer and E. L. Todd); ♂, Baboquivari Mtns., VI–19–1950 (L. D. Beamer); ♀, Organ Pipe National Monument, IV–13–1947 (A. L. Melander); ♂, Sabino Canyon, V–26–1962 (F. D. Parker and L. A. Stange); 2♂, Baboquivari Canyon, IV–9–1963 (R. C. Dickson); 2♂, ♀, Saguaro National Monument, V–3, 9–1960 (G. Butler); ♂, Santa Catalina Mtns., V–11–1961 (J. Bequaert); ♂, Santa Rita Mtns., VIII–9–1930 (R. H. Painter); ♀, Santa Rita Mtns., VIII–18–1935 (E. I. Beamer); ♀, Santa Rita Mtns., VII–20–1937 (Ruggles); 3♀, Sells, VII–31–1932 (R. H. Painter); ♀, 25 mi. SE Sells, VIII–2–1932 (R. H. Painter); ♂, Tucson, VIII–3–1930 (R. H. Painter); ♀, Tucson, IX–3 (F. M. Carpenter); ♂, ♀, 36 mi. SW Tucson, VIII–3–1932 (R. H. Painter); ♂, Tucson, IV–27–1948 (A. L. Melander); ♂, Cat Pass, Tucson Mtns., VIII–29–1913 (W. D. Pierce). *Pinal Co.*, ♀, 20 mi. S Florence, VIII–3–1949 (F. Werner and W. Nutting); ♀, Sacaton, VII–24–1932 (R. H. Painter); ♂, Rimrock, IV–29–1925. *Yavapai Co.*, 4♂, 3♀, 5 mi. N Wickenberg, IV–30–V–14–1937 (L. K. Gloyd).



MAP 9.—Distribution of *Anthrax atriplex*.

California: *Los Angeles Co.*, ♀, Attadena, VI–8–1914; 5♀, Bautista Canyon, V–5–1931 (C. H. and D. Martin); ♀, Tanbark Flat, VII–4–1950 (F. X.

Williams); ♂, Topango Canyon, VIII–5–1938 (Jean Russell). *Riverside Co.*, ♀, Anza, VIII–6–1935 (E. I. Beamer); ♀, McCoy Spring, IV–9–1963 (E. I. Schlinger). *San Bernardino Co.*, ♀, Wildwood Canyon, VII–13–1957 (H. R. Moffitt); ♀, 4 mi. N Cajon Jct., VII–4–1958 (J. C. Hall). *Santa Barbara Co.*, ♀, Bluff Camp, San Rafael Mtns., VI–29–1959.

New Mexico: *Dona Ana Co.*, ♀, Las Cruces, IV–25–1954 (R. H. Beamer). *Hidalgo Co.*, ♂, Steins, VIII–8–1932 (R. H. Painter). *Otero Co.*, ♂, Alamagordo, IV–30–1902. ♀, "Hot Springs," VII–22–1950.

Texas: *Brewster Co.*, ♂, 20 mi. S Marathon, IV–12–1949 (Michener and Beamer). *Dimmit Co.*, ♀, Carrizo Springs, IV–14–1949 (Michener and Beamer). *Maverick Co.*, ♂, Quemado, IV–14–1949 (Michener and Beamer). *Tom Green Co.*, ♂, San Angelo, VIII–29–1924 (R. H. Painter). *Uvalde Co.*, ♂, VII–26–1933 (A. W. Linquist). *Webb Co.*, ♂, Laredo, V–20/24–1948 (W. Nutting). *Zavala Co.*, ♂, Crystal City, IV–14–1952 (Michener, Beamer, Wille, and LaBerge).

Utah: *Iron Co.*, ♂, Parowan, VII–25–1919.

Mexico: *Baja California Sur*, ♀, 10 mi. SW San Jose del Cabo, VII–9–1938 (Michelbacher and Ross); ♀, "Canipole," X–2–1941 (Ross and Bohart). *Durango*, ♀, 15 mi. SW Pasaja, VIII–28–1929 (H. Smith). *Sonora*, ♀, Guaymas, VII–2–1952 (S. C. Dorman); ♂, Hermosillo, VIII–12–1959 (W. L. Nutting and F. C. Werner); ♀, 35 mi. N Hermosillo, IV–26–1961 (R. H. and E. M. Painter); ♂, ♀, 75 mi. S Hermosillo, IV–25–1961 (R. H. and E. M. Painter). *Tamaulipas*, ♂, 35 mi. S Matamoras, VIII–26–1954 (J. G. Chillcott); ♀, Santander Jimenez, VII–19–1962 (N. Marston–6).

Additional specimens have been examined from Gila, Maricopa, Pima, Pinal, and Santa Cruz counties, Arizona; Los Angeles, Riverside, and San Diego counties, California; Hidalgo County, New Mexico; Lake County, Oregon; Dimmit and Sutton counties, Texas; and Baja California Sur and Durango, Mexico.

TYPES.—The holotype and allotype are deposited in the collection of R. H. Painter. Paratypes may be found in the collections of the author, R. H. Painter, Jack C. Hall, the University of Arizona, the Canadian National Collection, the University of Kansas, Utah State University, the Museum of Comparative Zoology, the University of California, the Academy of Natural Sciences of Philadelphia, the University of Michigan, Oregon State University, the California Academy of Sciences, and the U.S. National Museum.

BIOLOGY.—Two specimens were reared by Dr. K. V. Krombein (1967) from the nests of *Megachile gentilis* Cresson (Hymenoptera: Megachilidae).

DISCUSSION.—*Anthrax atriplex* differs from *seriepunctatus* in having some black scales on the thoracic pleura, in having few, if any, white scales on the anterior three abdominal sterna, and in having the white scales on the posterior margins of abdominal terga two through five separated by patches of black scales. It differs from *melanopogon* in having the scales on the underside of the abdomen mostly black rather than mostly white, and in having the postalar tuft of pile mostly white rather than mostly black.

Anthrax melanopogon (Bigot)

Argyramoeba melanopogon Bigot, 1892, p. 348 [*Argyromoeba*].—Coquillett, 1894, p. 95.—Kertész, 1909, p. 65.

Spongostylum melanopogon.—Aldrich, 1905, p. 223 [*Spogostylum*].

Anthrax melanopogon.—Painter and Painter, 1962, p. 77; 1965, p. 432.

Spongostylum stellans.—Cole and Lovett, 1921, p. 244 [part] [*Spogostylum*] [not Loew, 1869; misidentification].

Anthrax seriepunctatus.—Maughan, 1935, p. 33 [*seriepunctata*] [not Osten Sacken, 1886; misidentification].

MALE.—Scales on head black and white. Basal antennal segments black; second segment saucer shaped, apical margin produced as sharp flange.

Scales on mesonotum mostly black, some white and gold scales present, especially along margins. Scales on scutellum black and white. Pile on mesopleuron and pteropleuron black and white, few brown hairs present. Scales on pleura mostly white, black scales sometimes present. Pile on prosternum, propleuron, and anterior margin of mesonotum mixed black and white, sometimes few brown hairs on last two; postalar tuft of pile mixed black and white, usually predominantly black. Scales on coxae white.

Cell C of wing (Plate 2*m*) usually entirely infuscated, sometimes hyaline along anterior margin beyond humeral crossvein. Base of wing infuscated out to bases of cells R, 2M, 1A and 2A; broad infuscated areas submedially on vein 2A, from base of cell Cu_1 to base of cell R, and from vein R_1 to vein M_{1+2} between bases of cells R_{2+3} and R_4; medial portion of cell 2M sometimes partly infuscated; isolated spots at bases of cells R_{2+3} and R_5, R_4, M_1, and $2M_2$, at medial angles of vein R_4 and m crossvein, apically on veins R_{2+3}, M_2, Cu_1, and sometimes Cu_2, subapically on vein R_{2+3}, and below tip of vein R_1; basal third of cell $1M_2$ sometimes partially infuscated.

Femora dark red to black, apices sometimes lighter. Scales on fore and middle femora black anteriorly, white posteriorly; hind femur with black scales, sometimes with few white scales posteroventrally.

Pile on sides of first abdominal tergum mostly white, some black hairs posteriorly; posterior margin with white scales laterally and black scales medially; sides of terga two through five with black setae, pile, and erect linear and lanceolate scales, some white scales posteriorly on three and five; sides of sixth and seventh terga with white scales. Discs of terga two through five with black scales; patches of white scales submedially on two through five, and sublaterally on four and five; patches of larger white scales sublaterally on two and three; terga six and seven with small black scales anteriorly on six, and medially on six and seven, remainder with white scales. Venter with sparse, threadlike white scales, usually some black scales medially on sterna three through seven.

FEMALE. Wing (Plate 2*n*) usually more extensively infuscated, cell 2M and bases of cells 1A and 2A entirely infuscated; spots on remainder of wings larger and sometimes coalesced.

MALE GENITALIA (Figure 32).—Similar to *pluto pluto*. Distal segment of gonostylus longer.

FEMALE GENITALIA.—Similar to *seriepunctatus*. Tenth tergum with nine spines. Ducts of spermathecae with two convolutions before widening to bulb.

BODY LENGTH.—9.2 to 12.2 mm.

WING LENGTH.—8.1 to 10.4 mm.

DISTRIBUTION.—*Anthrax melanopogon* occurs in mountain forests from southern California north to British Columbia and south in the Rocky Mountains to southern Colorado, northern New Mexico, and northern and eastern Arizona (Map 10). The type-locality is "Washington."

TYPES.—Painter and Painter (1962) designated as lectotype for this species a male specimen in the Bigot collection in the British Museum. They noted that the specimen was headless but otherwise in good condition and agreed well with Bigot's description.

DISCUSSION.—*Anthrax melanopogon* differs from *atriplex* in having the scales on the underside of the abdomen mostly white. It differs from *stellans* in having the scales on the ventral part of the hind femur black rather than golden brown and white, and in lacking gold scales on the underside of the abdomen. It differs from *seriepunctatus* in having cell 2M partially infuscated medially.

Anthrax cybele (Coquillett)

Argyramoeba cybele Coquillett, 1894, p. 96.—Kertész, 1909, p. 62.
Spongostylum cybele.—Aldrich, 1905, p. 222 [*Spogostylum*].
Anthrax cybele.—Painter and Painter, 1965, p. 431.

MALE.—Scales on head black, and white or yellow. Second antennal segment lenticular, apical margin not produced as a sharp flange.

Scales on mesonotum mixed yellowish white and black, margins with white scales, few yellow ones intermixed and some black ones on postalar callus. Scales on scutellum black, white, and yellow. Pile on mesopleuron and pteropleuron black. Scales on pleura gold and yellow. Prosternum with black pile; propleuron and anterior margin of mesonotum with mixed black and white pile, few yellow hairs on former. Postalar tuft of pile white. Scales on coxae gold and black.

Cells C and Sc of wing (Plate 2*o*) entirely infuscated. Cells R, 1M, and 2M entirely infuscated except for subapical and submedial hyaline spots in former, and apical stigmatic area in latter. Cell 1A with postbasal subhyaline spot, and postmedial and apical hyaline areas. Cell 2A with broad infuscated area submedially on vein 2A not reaching posterior margin, and small subapical spot on vein 2A. Cell R_1 infuscated out to tip of vein Sc except for basal hyaline spot; cell $1M_2$ infuscated on basal third except for small hyaline spot basally on vein Cu_1. Bases of cells R_{2+3}, R_5, and Cu_1, infuscated. Independent spots at bases of cells R_4 and M_1, in cell R_1 below tip of R_1, on vein R_{4+5} between bases of cells R_{2+3} and R_4, and medially on m crossvein.

Fore and middle femora and tibiae with black scales posteriorly and white scales anteriorly; hind femur and tibia with black scales.

Sides of first abdominal tergum with dense white pile, few yellow hairs posteriorly; hind margin with black scales medially and white scales laterally. Sides of terga two through seven with black setae and few linear black scales. Discs of terga with mostly black scales; white scales laterally and medially on posterior margin of second tergum, laterally on terga six and seven, and medially on third tergum. Venter with linear black scales, a few yellowish-white scales laterally on posterior margins of second and following sterna.

FEMALE.—Similar to male. Sternopleuron with some black scales. Cell 2M of wing with hyaline area basally. Venter of abdomen without light scales.

MALE GENITALIA (Figure 29).—Distal part of gonocoxites parallel sided in lateral view, rounded apically; apices sharply rounded in ventral view, with mesal ridges defining shallow medial sulcus. Distal segment of gonostylus inverted-trapezoidal basally, with narrow apical hook. Apex of epiphallus with sharp lateral angles, proximal process large, sharply recurved. Aedeagus narrow and sharp apically, gonopore ventral. Basal part of aedeagus enlarged, bulbous; lateral and proximal apodemes small in relation to base of aedeagus.

FEMALE GENITALIA (Figure 40).—Similar to *pluto pluto*. Tenth tergum with 12 spines on each side. Sclerite on each side of gonopore very narrow dorsally, with spurlike mesal extension and narrow, spatulate outer lobe.

BODY LENGTH.—6.7 to 7.4 mm.

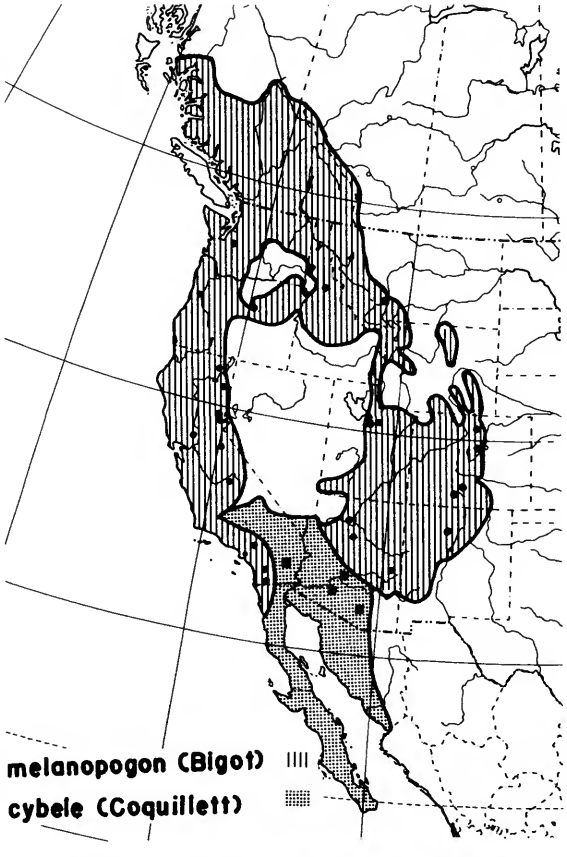
WING LENGTH.—6.1 to 6.7 mm.

DISTRIBUTION.—*Anthrax cybele* probably occurs from southern California to southwestern Arizona and into northwestern Mexico (Map 10).

NEW MATERIAL EXAMINED.—Arizona: *Maricopa Co.*, ♂, Phoenix, IV–19–1931 (E. M. Painter); ♀, Gila Bend, IV–23–1935 (F. H. Parker). *Pima Co.*, 2♀, 5 mi. W Tucson, VIII–5–1961, 2300 feet (R. H. and E. M. Painter).

California: *Riverside Co.*, ♀, 20 mi. E Indio, IV–26–1963 (E. I. Schlinger).

DISCUSSION.—*Anthrax cybele* is a very distinctive species. It may be distinguished from all the species in the *oedipus* group except *irroratus* Say by the lenticular form of the second antennal segment. It differs from *irroratus* in that cells C and Sc are entirely infuscated rather than with alternating hyaline and pigmented spots.



MAP 10.—Distribution of *Anthrax melanopogon* and *A. cybele*.

Anthrax cephus Group

The *cephus* group is the largest and most diverse group in the genus *Anthrax* in the New World. Thirty names have been proposed to date in the group. Of these, thirteen are synonyms, one is a homonym, and one is relegated to subspecific rank. In addition, twelve new species and one new subspecies are described here, making a total of 29 taxa known from North and South America.

Specimens of the *cephus* group may be separated from species of other groups most readily by the setae on the face, which extend almost to the level of the antennae rather than restricted to the lower and lateral margins. *Anthrax plurinotus* of the *trimaculatus* group has the setae distributed in this way, but it has distinct, isolated spots at the bases of the apical cells.

Approximately 1400 specimens in this group have been studied. These represent the majority of specimens in North and South American museums. All except about 20 have been assigned with relative certainty to the various taxa recognized. The few unassigned specimens may represent individual variants, intermediates between species or subspecies, or possibly distinct taxa too poorly represented to be recognized. These specimens are discussed under the species to which they seem most closely related.

Group Description

Body generally black; tibiae and male genitalia usually red or yellow, femora and parts of thoracic

pleura, basal antennal segment, and parts of abdominal sterna sometimes red or yellow. Pruinosity generally gray and brown, silver along margins of eyes, sometimes velvet black above on thorax and abdomen. Head globoid, eyes separated at vertex by 1.0 to 1.5 times width of ocellar tubercle in male, 2.0 to 2.5 times its width in female. Antennal sockets separated by 0.25 to 1.0 of their diameters, separated from eye margins by 0.5 to 0.75 of their diameters. Face projecting slightly above level of eyes, oral margin evenly rounded or obtusely angular. Front covered with light or dark setae and sparse lanceolate scales of variable color. Face with dense setae extending from oral cavity almost to antennal sockets; sparse scales along eye margins and sometimes over entire face. Setae and scales on occiput and fringe of pile on posterior margin unicolorous or light below and dark above. First antennal segment narrow basally, more or less enlarged mesad apically, 0.75 to 2.0 as long as apical width and entirely covered with setae. Second segment lenticular or globoid, somewhat narrower than apex of first segment and with setae dorsally and laterally. Third segment bulbous or hemispherical basally, tapering abruptly or gradually to a styliform apex; base sometimes flattened mesolaterally, usually as wide as second segment in mesal view and slightly narrower in dorsal view; styliform part 0.5 to 1.5 times as long as base, 1.0 to 2.5 times as long as style; style 1.0 to 4.0 times as long as wide, with a distinct apical tuft of setae.

Mesonotum with fine setae scattered over disc and with bristles and coarse setae along lateral margins; recumbent linear scales present on disc, becoming curly and semierect along lateral margins; anterior margin with long hairs and setae. Scutellum with fine setae and linear scales on disc, and long setae and broader scales posteriorly and laterally. Mesopleuron with coarse setae and pile above, with fine setae, pile and erect scales below. Pteropleuron with coarse setae and fine pile and scales on anterior half, posterior part usually bare, rarely with long linear, curly scales. Sternopleuron with fine setae and linear or lanceolate, recumbent scales. Hypopleuron bare or with a patch of short setae or scales at anterior corner. Metapleuron sometimes with a patch of linear or lanceolate scales behind or below spiracle. Propleuron and prosternum with long, erect pile. Postalar tuft of pile often with a few linear scales at base. Coxae with bristles and lanceolate semierect scales.

Wing pigmented anteriorly and basally, hyaline apicoposteriorly, or entirely pigmented, rarely nearly hyaline; no isolated spots present in apical part of wing. Posterobasal part of wing often greatly narrowed with posterior margin of cell 2A concave, or broadened with cell 2A twice as wide as cell 1A; alula well developed with posterior margin rounded, or reduced with posterior margin straight or concave. Base of cell R_4 rounded, angled with a spur, or connected to vein R_{2+3} forming a sectoral crossvein; vein R_4 without a medial spur. Base of cell R_{2+3} rounded or with a short or long spur. R–m crossvein located at basal fifth or two-fifths of cell $1M_2$. M crossvein sometimes supporting a spurious vein extending from near its apex to posterior margin near apex of vein Cu_1. Contact of cells $1M_2$ and Cu_1 0.5 to 3 times as long as base of cell Cu_1. Calypteres lightly pigmented; knob of halteres more or less pigmented basally, usually yellowish apically.

Fore and middle femora with or without a more or less extensive anteroventral row of macrochaetae; middle femur sometimes with one or more bristles postmedially on the anterior side; hind femur with a more or less extensive row of bristles anteroventrally and sometimes with a few bristles apically on the posterodorsal and posteroventral sides. Fore tibia with rows of macrochaetae posteroventrally, posterodorsally and sometimes anterodorsally; middle and hind tibiae with rows of macrochaetae at all four angles; anterodorsal row on latter sometimes double. Scales on femora and tibiae entirely dark or sometimes light posteriorly; scales on hind tibiae semierect when a double row of macrochaetae is present anterodorsally.

Sides of first abdominal tergum with dense pile; sides of posterior terga with fine setae and semirecumbent or semierect linear or lanceolate scales, some pile often present laterally on terga two and three. Posterior margin of first tergum and surfaces of following terga with sparse, fine black setae and linear or lanceolate, dense, dark scales; broader, light scales often present along posterolateral margins of terga one through four. Lateral portions of fifth tergum and much or all of terga six and seven of male often with dense, overlapping, posteriorly or posterolaterally directed silver scales. Females often with patches of silver scales laterally on terga four, five, and six. Venter with fine long setae, and scattered lanceolate or linear scales of variable color.

Apices of gonocoxites of male genitalia rounded or acuminate, often with medial carinae defining a medial sulcus, rarely with lateral carinae; setae on gonocoxites sparse and coarse, sometimes more dense

medially toward apex. Basal segment of gonostylus usually inconspicuous, rarely produced as an acuminate lobe or a broad, flat plate apically. Distal segment of gonostylus variable in form, usually extending apicolaterally, but rarely dorsolaterally. Apex of epiphallus with a dorsal spine, transverse shield, or raised plate, sometimes flattened with recurved lateral lobes. Basal part of aedeagus bulbous or tubular. Dorsal bands of epiphallus bare or with fine setae.

Eighth tergum of female with dense, fine hairs extending apically, basal medial process long, narrow and laterally flattened, or vestigial. Tenth tergum with one to thirty stiff spines on each side surrounding the cerci. Sclerites on ninth sternum usually hatched shaped, quite variable in form. Ventral arms of ninth tergum simple and acuminate or broadened apically. Spermathecal tubes of variable length, plastic or stiff, rarely contorted before bulbs; bulbs tubular to spherical or awl shaped, usually symmetrical, but sometimes with apex produced slightly laterad.

Taxonomic Characters

The extent of the wing pigmentation is the most valuable taxonomic character for separating species of the *cephus* group. The intensity of pigment is less useful, however, since it is difficult to define and varies considerably in certain species. A sectoral crossvein between vein R_{2+3} and the basal angle of vein R_4 is present in the males of *delicatulus* and *innubilipennis*. The species related to *pluricellus* have an additional vein extending from the m crossvein to the wing margin just above the apex of vein Cu_1. Thus, these species may key to the family Therevidae in some texts. This particular vein has both origin and insertion different from that extending from the m crossvein to vein Cu_1 in species of the *tigrinus* group.

The form of the wing is a good taxonomic character. The species *luctuosus* and *cathetodaithmos* have the wing broader than is usual in species of *Anthrax*. In this case the cells are somewhat shorter and broader, particularly those of the anal area. Cell 2A is more than 1.5 times broader than cell 1A which is itself broadened. At the other extreme, the species of the *argyropygus* complex have the wings elongate and usually narrowed. The anal margin of the wing is greatly reduced with cell 2A narrower than cell 1A and with the posterior margin concave. The majority of the species are intermediate between these two conditions, but there is little intraspecific variation. The shape of the alula may be an excellent diagnostic character in that its margin may be straight or rounded, or it may even be vestigial as in *argyropygus*. The alula is defined as the membranous lobe at the base of the wing before the bases of cells 1A and 2A. It is clearly shown in Plate 3*f*.

Under the species *analis* and *gideon* several forms have been discriminated which have wing patterns grossly different from those of typical specimens. These forms probably were derived from isolated populations that were reunited subsequently and interbred freely with the parent population. Their origins are discussed under the section on evolution. As interpreted here, the forms have no taxonomic status but are briefly described lest ignoring them might lead to confusion.

The chaetotaxy of the legs is quite variable in the *cephus* group in contrast to the *albofasciatus* and *oedipus* groups. In the primitive condition there are four to six strong anteroventral bristles on the middle and hind femora. These are progressively reduced in the species of the *analis* complex, with *analis* and *repertus* having only one or two weak bristles apically. In the species of the *cephus* complex the number of femoral bristles may be increased. In addition, the species of the *cephus* complex, and *delicatulus* and *innubilipennis*, have one or more postmedial bristles on the anterior side of the middle femur. These are in the same position as those found on *oedipus* in the *oedipus* group. The species of the *cephus* complex also have the anteroventral row of bristles on the hind tibia doubled with the intermixed scales semierect.

The form of the antennae is quite variable among the different species. Since the form is very difficult to describe and varies somewhat due to unequal shrinkage during drying, it is not used extensively in classification. The drawings (Figures 95–120), however, may be helpful in verifying the identity of species.

The male and female genitalia are distinctive in almost all of the species. Those of the male are especially complex and have been most useful in segregating the species of the group. Since the best characters are internal, however, they are not emphasized in the key and diagnoses. The terms employed are illustrated in Figures 50 and 75.

Evolution

Since the *cephus* group is restricted to North and South America, it is possible to consider more easily

the origins and relationships of the species. Similar patterns of distribution have been observed in other bombyliid genera, and it is hoped that this discussion will provide an impetus for the future consideration of distributional patterns and species relationships in an evolutionary context. It should be emphasized that the patterns expressed here are strictly hypothetical. Alternative hypotheses may explain the distribution of the species, but the patterns described seem to fit best the available evidence.

The patterns have been determined by considering the distributions and phenetic relationships of the species along with their ecological preferences, where these are known, and, working backward through the Pleistocene, postulating the effects of climatic and geographical changes on the changing populations. Since the relationships of populations become less certain as one goes back through time, the origins of populations necessarily become more vague.

The evolution and dispersal of the species complexes of the group are illustrated in Figures 1–6. A hypothetical center of dispersal is indicated by a black circle and the main lines of dispersal radiate from it. Barriers which have resulted in speciation (or subspeciation) are indicated by broken lines. The hypothetical lines of dispersal leading to the present distributions of the taxa are indicated by narrow lines branching from the main trunks.

Several modes of speciation seem to have been involved in the evolution of the *cephus* group. The first is the classical case of separation by water as by the inundation of portions of the Isthmus of Panama during the interglacial periods of the Pleistocene, or by the separation of island faunas. According to Dunbar (1949), if the modern ice sheets of Greenland and Antarctica melted, as they apparently did during the interglacial periods, sea level would rise by as much as 100 feet, inundating low-lying areas in the Isthmus of Panama. Conversely, if the great continental ice sheets were restored, sea level would fall by as much as 300 feet, shifting the shore line seaward to the present 50-fathom line. The separation of populations in northwestern South America and southern Mexico has occurred repeatedly and apparently has been one of the primary factors effecting the evolution of the *cephus* group. Because only portions of the Isthmus were inundated, even during the period of highest sea level, islands would have been formed on which small populations could have been isolated. This may have been the origin of the species *costaricensis*.

Isolation of populations due to climatic change also has been an important factor in the evolution of the *cephus* group. The cool, wet climate during the glacial periods would have resulted in the shifting toward the equator of biotic zones and the increase in extent of forests, whereas during the interglacial periods biotic zones would have expanded toward the poles and areas of desert and grassland increased in extent (Martin, 1958). Because most of the species of the *cephus* group are forest inhabitants, the interruption of contiguous forest belts during dry periods has resulted in differentiation of populations. This apparently has occurred at intervals in south-central Brazil, northeastern Mexico, and south-central United States. Here again, small populations may be isolated on ecological islands surrounded by an inhospitable area, although no examples have been noted in the *cephus* group.

If such ecological islands were to change gradually to a new type of habitat (e.g., from forest to grassland) the isolates would be under strong selective pressure to adapt to the new conditions. The result of such a change, after dispersal in the new habitat, would be allopatric species or subspecies occupying adjacent habitats. This type of relationship has been observed commonly in the Bombyliidae and probably is the way *analis* and *repertus* became adapted to dry habitats. It would also explain the separation of *argentatus* and *nitidus*.

The species that retains the most generalized characters in the group is *argentatus*, which is endemic to the coniferous forests of northwestern United States and southwestern Canada. Since it has characters in common with several Palaearctic species of *Anthrax*, it seems probable that it was derived from a Eurasian ancestral population by way of the Bering Strait, and that it retains some primitive characters because of the lack of selective pressure in its relatively stable environment.

The migration of the ancestral population into North America probably took place during the Pliocene, or perhaps slightly earlier, when floras similar to those in northwest United States existed in Alaska (Chaney, 1940). Although the continents of North America and Asia were connected several times during the glacial periods of the Pleistocene, the climate was probably too rigorous to allow the survival of Bombyliidae at that time (Hopkins, 1959).

Cockerell (1914) indicates that no fossil Anthracinae (in his interpretation, Anthracinae and Exopro-

sopinae) were found in extensive collections of fossil Bombyliidae from the Miocene Florissant shales of Colorado. He postulates that this group arose in the Old World and migrated to North America during or after the late Miocene. This agrees with my interpretation.

Although *argentatus* is a species adapted to northern climates, as its ancestor presumably was, the greatest diversification of the group has taken place in tropical and subtropical areas. The adaptation of the ancestral stock to tropical and subtropical forests probably took place during and after the first glacial period of the Pleistocene. As the climate gradually cooled during the early Pleistocene, the ancestral population was driven southward. According to Sears and Clisby (1955), spruce (*Picea sp.*) grew in the area of Mexico City during the most recent glacial period, which indicates that more temperate coniferous forests (such as those to which *argentatus* is presently adapted) may then have extended south into Central America, and probably during the previous periods. If this were the case, the ancestral population probably migrated as far as southern Mexico or Central America during the first glacial period. As the boreal forest retreated during the first part of the first interglacial period, small populations of flies would have been isolated on mountaintops where they would have been under strong selective pressure to adapt to the warming environment. As the isolates adapted to the new environment they would have been free to disperse throughout the tropical and subtropical areas from southern Mexico to southeastern Brazil.

After their dispersal during the first part of the first interglacial period, the population would have been split into three segments by the inundation of the Isthmus of Panama and the separation of the tropical forest in southeast Brazil from that around the Amazon Basin at the height of the interglacial period (Figure 1).

One of these segments, probably that in northwestern South America, may have evolved to the *luctuosus* complex. *Anthrax luctuosus* and *cathetodaithmos* are well-defined species with a strong resemblance in the structure of the male genitalia to *argentatus*, but the broad wings with a distinctive pattern and the structure of the female genitalia indicate that there is no close relationship with any other species of the *cephus* group. The two species probably were derived from populations isolated by an inundation of the Isthmus of Panama and since have become partially sympatric in Central America and northwest South America (Figure 3). At present, *luctuosus* has expanded over a wide range of tropical habitats.

The segment of the ancestral population isolated in southeast Brazil may have evolved to the present species *hylaios*. Like the *luctuosus* complex, *hylaios* shows no close relationship to other species of the *cephus* group, which may indicate that it was isolated early in the history of the group. This species has not expanded its range beyond the Serra do Mar of southeast Brazil.

The third segment of the ancestral population, probably that in southern Mexico, apparently gave rise to most of the remaining species of the *cephus* group. After expansion of its range during the second glacial period, this population would have been split at the Isthmus of Panama and south-central Brazil during the second interglacial period into three populations, one giving rise to the *analis* complex in southeast Brazil, the second to the *argyropygus* complex in northwest South America, and the other to the *cephus* complex in southern Mexico.

The third glacial period with the accompanying cool, wet climate and low sea level probably allowed the ancestral population of the *cephus* complex to disperse throughout southern Mexico and northwestern South America, and into southern Brazil. During the first part of the following interglacial period the ancestral population also migrated into eastern North America. At the middle of the period, the four populations were isolated in these areas and developed into distinct species (Figure 5). The relationship of these four taxa has not changed greatly since they were isolated, although the expansion of forests during the last glacial period has made possible the expansion of the ranges of the Neotropical species to their present locations. Although *cephus* and *aterrimus* are superficially similar, their basic characters show no closer relationship than with the other species of the complex.

During the third glacial period, the pre-*argyropygus* population probably migrated north into Mexico and southeast to the coast of Brazil, and one part apparently moved up the Lesser and Greater Antilles to the island of Jamaica where it has evolved into the species *delicatulus*. With the isolation of the Mexican population during the third interglacial period, and the expansion and contraction of the range of the popula-

tion during the fourth glacial period and up to the present, the species *costaricensis, snowi,* and *pluricellus* have been disassociated. The species *laticellus* may have reached Arizona during the first part of the third interglacial period, after which it was isolated (Figure 4).

Toward the end of the third interglacial period, the pre-*argyropygus* ancester again expanded into Mexico, Arizona, and eastern North America. The recent warmer and drier climate has resulted in the isolation of *argyropygus painteri* in Arizona and the semi-isolation of *argyropygus albosparsus* in southern Mexico, as well as the restriction of the range of *argyropygus argyropygus* to include eastern United States, and the Gulf coast of Texas and eastern Mexico. *Anthrax angustipennis* remains in northwestern South America and has expanded into southeastern Brazil (Figure 6).

The exact relationship between *angustipennis, macquarti,* and *repertus* in South America is open to question. Whereas the structure of both the male and female genitalia indicate a close relationship between *macquarti* and *repertus,* the reduced anal margin of the wing indicates a close relationship between *macquarti* and *angustipennis.* Also, a specimen has been studied which appears to be an intermediate between the last two species. A possible explanation is that *macquarti* was isolated from *angustipennis* in southeast Brazil during the third interglacial period. *Anthrax austrinus,* a close relative of *macquarti,* occurs in south Brazil. It may have been separated from *macquarti* by the cold uplands in southern Paraná during the last glacial period (Figure 5).

The *analis* complex probably evolved from an ancestral form during the second interglacial period in southeastern Brazil. During the third glacial period it expanded into Central America and, during the third interglacial period, into North America. Also, it apparently has migrated by way of the Bahama Islands from Florida to the West Indies, probably during the fourth glacial period. During the third interglacial period, the North American population was isolated from that in northwestern South America and evolved to the present species, *analis.* Apparently, the population in Florida was also isolated for a short time during the third interglacial period but was reunited with resulting hybridization giving rise to the forms now recognized in the southeastern United States. The West Indian population has evolved to *funebris.* In South America, the northwestern population was apparently isolated from that in eastern Brazil by the restriction of forests in south-central Brazil. The northwestern population gave rise to *gideon,* the southeastern population to *repertus.* It is not clear how *clinopictus* and *repertus* were separated. Perhaps the pre-*repertus* form became adapted to a dry habitat, as it is now, and was semi-isolated in northeastern Brazil, whereas *clinopictus* remained in the forest area of south-central Brazil. At any rate, the two species are distinct because they are now at least partly sympatric. From the last glacial period up to the present, *gideon* has expanded its range into southern Mexico and the coastal forest of southeast Brazil, while *repertus* has expanded into grassy or semidesert areas from southern Brazil through the Guianas to Central America and along the Pacific coast southward into Peru. *Anthrax analis* has expanded its range throughout the United States and northward far into Canada. In southern Mexico, it is sympatric with *gideon* and intermediates have been seen from one locality (Figure 2).

The separation of *argentatus* and *nitidus* probably took place during the third interglacial period. When the pre-*argentatus* population retreated from Arizona during this time, a small isolated population probably became adapted to the desert habitat and has expanded to become allopatric to *argentatus* as it is at present.

In addition to the above species, four anomalous species are known from only one locality. *Anthrax inaquosum* is known from Mossoró, Rio Grande do Norte, Brazil. It apparently is not closely related to any other species in the group. It may have had an origin separate from that of the *cephus* group in South America.

Anthrax innubilipennis is known from only three males collected at Iguala, Guerrero, Mexico. It is most closely related to *delicatulus* from Jamaica. The origin that would best fit into the evolutionary scheme given above is from Jamaica into southern Mexico by way of Costa Rica or Nicaragua during the fourth glacial period (Figure 4).

Anthrax koebelei is known from only three complete reared specimens labeled "Arizona." The male genitalia are most similar to the *analis* complex, and *koebelei* may have been derived from an "off-shoot" of the pre-*analis* population during the third interglacial period.

Anthrax xanthomeros is known from only one specimen collected at Benque Viejo, British Honduras. It seems to be a rather primitive species with no close relationship to other taxa.

Key to the Species of the *Anthrax cephus* Group in North and South America

1. Cell $2M_2$ divided by a crossvein extending from m crossvein obliquely to wing margin just above apex of vein Cu_1 (Plate 4*a*) 2
   Cell $2M_2$ not divided by such a crossvein 4

2(1). Femora black. Anterior terga and scutellum with only black scales 3
   Femora yellow. Golden-brown scales along posterior margins of terga and on scutellum; lateral margins of abdomen with tufts of golden-brown hairs posteriorly. Eastern Mexico ..... ***pluricellus*** Williston

3(2). Cells 1A and 2A of wing entirely pigmented; cell R_1 pigmented apically only along the anterior margin. Pigment of wing dark brown (Plate 4*b*). Costa Rica ..... ***costaricensis***, new species
   Cells 1A and 2A hyaline apically; cell R_1 completely pigmented apically. Pigment of wing light brown (Plate 4*a*). Arizona ..... ***snowi***, new species

4(1). Posterior margin of alula straight or slightly concave (Plate 5*l*); wing usually elongate and narrow with anal margin reduced 5
   Posterior margin of alula distinctly convex (Plate 4*g*); wing not particularly elongate and narrow, the anal margin not reduced 20

5(4). Vein R_4 joined to vein R_{2+3} by an evenly curved sectoral crossvein (Plate 5*a, c*). Middle femur with a postmedial bristle anteriorly 6
   Vein R_4 not joined to vein R_{2+3} (in rare instances the veins may be joined by an adventitious crossvein, in which case it is angled and may bear short spurs). Middle femur usually without a postmedial bristle anteriorly 7

6(5). Anterior margin of wing pigmented out to apex of cell R_1; cell M mostly pigmented (Plate 5*a*). Jamaica and Dominican Republic ..... ***delicatulus*** Walker, ♂
   Wing mostly hyaline; cells C and Sc and extreme base of wing pigmented (Plate 5*c*). South-central Mexico ..... ***innubilipennis***, new species, ♂

7(5). Males 8
   Females 14

8(7). Cell M entirely pigmented 9
   Cell M hyaline medially (Plate 5*g*). Arizona (Map 20) ..... ***argyropygus painteri***, new subspecies, ♂

9(8). Posterior margin of cell 2A convex 10
   Posterior margin of cell 2A concave 13

10(9). Pigment extending from cell R_{2+3} into cell R_5 beyond r-m crossvein (Plate 5*f, k, l*). Cell 2A not narrowed, as broad as cell 1A 11
   Cell R_5 hyaline beyond r-m crossvein. Cell 2A narrower than cell 1A (Plate 5*d*). Amazon Basin, northwestern South America and southeastern Brazil (Map 19) ..... ***angustipennis*** Macquart, ♂

11(10). Cell 2A more than one-half pigmented; no spots of darker pigment present at bases of cells. South America 12
   Cell 2A entirely hyaline or only lightly pigmented at extreme base; bases of cells R_4, R_{2+3}, and R_5, and Cu_1 with spots of darker pigment (Plate 5*f*). Arizona ..... ***laticellus***, new species, ♂

12(11). Wing pigment extending along vein Cu_2 almost to wing margin, leaving a large, semi-isolated hyaline area apically in cells 1A and 2A; pigment in cell R_{2+3} extending more than three-fourths of way to base of cell R_4 (Plate 5*l*). Dorsum of thorax and terga with some orange-brown linear scales. Santa Catarina and Rio Grande do Sul in Brazil ..... ***austrinus***, new species, ♂
   Wing pigment not projecting along vein Cu_2 forming a semi-isolated hyaline area apically in cells 1A and 2A; pigment in cell R_{2+3} extending less than two-thirds of way to base of cell R_4 (Plate 5*k*). Dorsum of thorax and abdomen without orange-brown scales. Southeast Brazil to the Andes Mountains (Map 21) ..... ***macquarti*** d'Andretta and Carrera

13(9). Mesonotum, scutellum, and anterior terga without patches of gold scales. Ventrolateral part of apex of epiphallus projecting apically creating a deep medial emargination (Figure 67). South-central Mexico (Map 20)..***argyropygus albosparsus*** (Bigot), ♂

Mesonotum, scutellum, and anterior terga with patches of gold scales (except in specimens from Florida). Ventrolateral part of apex of epiphallus not projecting apically, medial emargination shallow (Figure 66). Eastern United States, extreme southeastern Canada, and eastern Mexico (Map 20)..... .....***argyropygus argyropygus*** Wiedemann, ♂

14(7). Cell 2A partially pigmented basally; more than half of cell 1A pigmented. Eastern United States to South America.....15

Cell 2A hyaline; less than half of cell 1A pigmented (Plate 5*n*). Arizona (Map 20). .....***argyropygus painteri***, new subspecies, ♀

15(14). Pigment in cell R_1 extending past tip of vein R_1 to apex of cell. Eastern North America, Mexico, and West Indies.....18

Pigment in cell R_1 not extending past tip of vein R_1. Northern and eastern South America (if specimens from Arizona key out here, see *laticellus*).....16

16(15). Pigment extending from cell R_{2+3} into cell R_3 beyond r-m crossvein leaving a basal hyaline area in cell R_3 (spot of pigment sometimes very faint) (Plate 5*k*, *l*).....17

Pigment not extending into cell R_3 beyond r-m crossvein (Plate 5*e*). Northwestern South America, Amazon Basin and southeastern Brazil (Map 19)..... .....***angustipennis*** Macquart, ♀

17(12). Wing pigment extending along vein Cu_2 almost to wing margin, leaving a large, semi-isolated hyaline area apically in cells 1A and 2A; pigment in cell R_{2+3} extending more than three-fourths of way to base of cell R_4 (Plate 5*l*). Dorsum of thorax and abdomen with some orange-brown linear scales. Santa Catarina and Rio Grande do Sul in Brazil.....***austrinus***, new species, ♀

Wing pigment not projecting along vein Cu_2 forming a semi-isolated hyaline area apically in cells 1A and 2A; pigment in cell R_{2+3} extending less than two-thirds of way to base of cell R_4 (Plate 5*k*). Dorsum of thorax and abdomen without orange-brown scales. Southeastern Brazil to the Andes Mountains in northwestern South America (Map 21).....***macquarti*** d'Andretta and Carrera, ♀

18(15). Middle femur without a bristle postmedially on anterior side (above anteroventral row). Eastern North America and Mexico.....19

Middle femur with a distinctive bristle or bristles postmedially on anterior side. Jamaica and Dominican Republic. (If specimens from Mexico key to this species, see *A. innubilipennis*).....***delicatulus*** Walker, ♀

19(18). Mesonotum, scutellum, and anterior terga with patches of gold scales (except specimens from Florida). Pile on mesopleuron and sternopleuron largely black or gold. Extreme southeastern Canada, eastern United States, and eastern Mexico (Map 20)..... .....***argyropygus argyropygus*** Wiedemann, ♀

Mesonotum, scutellum, and anterior terga without patches of gold scales. Pile on mesopleuron and sternopleuron largely pure white. South-central Mexico (Map 20). .....***argyropygus albosparsus*** (Bigot), ♀

20(4). Anterior corner of hypopleuron with a tuft of setae and/or scales. Middle femur with a postmedial bristle or bristles above the anteroventral row.....21

Anterior corner of hypopleuron bare. Middle femur without bristles above anteroventral row 24

21(20). Wing entirely pigmented or with only a narrow hyaline area apically.....22

Apical half of wing hyaline.....23

22(21). Discs of cells subhyaline, pigment darker along veins (Plate 4*d*). Southeastern United State (Map 18).....***aterrimus*** (Bigot)

Pigment in discs of apical cells as dark as that along veins (Plate 4*c*), apical margin of wing sometimes hyaline. Central America, Amazon Basin, and southern and eastern Brazil (Map 17).....***cephus*** Fabricius

23(21). Pile on lateral margins of first tergum predominantly white. Pile on pleura white, brown, or mixed. Pigment on wing light brown (Plate 4*e*). Southern Mexico to southern Brazil (Map 15) ..... ***midas*** Fabricius

Pile on lateral margins of first tergum black. Pile on pleura black. Pigment on wing dark brown (Plate 4*f*). Southern Panama, Amazon Basin, and southern and eastern Brazil (Map 16) ..... ***hyalacrus*** Wiedemann

24(20). Pigment filling base of wing at least out to bases of cells R_5, $1M_2$, and Cu_1 25

Wing nearly hyaline, small yellowish-brown spots present at bases of cells R_{2+3} and R_5, in cell R below base of cell R_1 and at bases of cells $1M_2$ and Cu_1 (Plate 3*k*). Northeastern Brazil ..... ***inaquosum***, new species

25(24). Body densely pruinose; if integument is shining, then pigment of wing dark brown or more extensive than in 25b 26

Body mostly shining black with sparse pruinosity. Pigment of wing light brown, translucent, extending out to bases of cells R_{2+3} and R_5, $2M_2$ and Cu_1, and leaving apices of cells 1A and 2A broadly hyaline (Plate 3*j*). Arizona and southern California (Map 11) ..... ***nitidus***, new species

26(25). Apical margin of wing pattern irregular or wing entirely pigmented; apical part of cells C and Sc pigmented 28

Apical margin of wing pattern straight, perpendicular to wing axis; apical part of cells C and Sc not pigmented (Plate 4*l*) 27

27(26). Posterior part of pteropleuron bare; setae, pile, and scales on mesopleuron and sternopleuron black. Fringe of hairs on posterior margin of occiput black. South-central Mexico to Peru (Map 13) ..... ***cathetodaithmos***, new species

Posterior part of pteropleuron with linear, woolly, gold or yellowish-white scales; pile, setae, and scales on mesopleuron and sternopleuron white or yellowish white, a few black setae sometimes present. Fringe of hairs on posterior margin of occiput white or yellowish white. Southern Mexico to southeast Brazil (Map 12) ..... ***luctuosus*** Macquart

28(26). Pigment on wing not extending almost to apex of cell R_1 or, if so, then not extending across cell R_{2+3} to vein R_4, not leaving a hyaline area before the base of cell R_4. First antennal segment dark red or black; femora, tibiae, and pleura black (femora rarely yellow). Base of third antennal segment usually constricted abruptly to styliform part in mesal view 29

Pigment on wing extending apically almost to apex of cell R_1 and thence across cell R_{2+3} to vein R_4, leaving a hyaline area before base of cell R_4 (Plate 4*g*). First antennal segment yellow; femora, tibiae, and lower pleura yellow. Base of third antennal segment tapering gradually to styliform part in mesal view (Figure 103). Tropical forests in southern and eastern Brazil (Map 14) ..... ***hylaios***, new species

29(28). Femora black or dark red or, if yellow, then cell 2A more than one-half pigmented. . 30

Femora orange, with five to seven strong macrochaetae on middle and hind pairs. Wing pattern as in Plate 3*g*, cell 2A less than one-half pigmented. Margins of mesonotum, scutellum, and posterior margins of abdominal terga with rusty brown scales. British Honduras ..... ***xanthomeros***, new species

30(29). Wing at least slightly hyaline apically 32

Wing entirely pigmented 31

31(30). Third antennal segment with styliform part at least 1.5 times as long as base (Figure 116). Southeast United States ..... ***analis*** Say, f. ***grossbecki*** (Johnson)

Third antennal segment with styliform part about equal in length to base. Arizona ..... ***koebelei***, new species

32(30). Posterolateral margins of terga two and three without white scales, linear yellow scales sometimes present; silver scales on posterior terga of male parallel to axis of body. Styliform part of third antennal segment more than 1.5 times longer than basal part in dorsal view (Figure 116) (*analis* complex) 33

Posterolateral margins of terga two and three with patches of lanceolate, truncate, white scales; silver scales on posterior terga of male diagonal to axis of body. Styliform part of third antennal segment about equal in length to basal part (Figure 102). Mountainous areas from Colorado north to British Columbia and south into southern California (Map 11) ..... ***argentatus*** (Cole)

33(32). Cells 1A and 2A of wing completely pigmented or with only extreme tip of cell 1A subhyaline. Nearctic and Neotropical species.....34

Cells 1A and 2A of wing hyaline apically for a distance equal to length of r-m crossvein. (If from United States, see *analis* Say). Neotropical species.....39

34(33). Cell $1M_2$ of wing more than three-fourths pigmented; cell R_5 pigmented beyond base of cell M_1.....35

Cell $1M_2$ of wing less than three-fourths pigmented; cell R_5 not pigmented beyond base of cell M_1, or, if so, then cell $1M_2$ less than half pigmented.....37

35(34). Apex of cell M_1 more or less hyaline; apical third or fourth of cell Cu_1 hyaline.....36

Wing of female entirely pigmented (Plate 3*c*); wing of male with a narrow hyaline area along apical margin from apex of vein R_{2+3} to apex of vein Cu_1; cell Cu_1 entirely pigmented or with a small subhyaline area at anteroapical margin (Plate 3*b*). Florida.....***analis***, f. ***grossbecki*** (Johnson)

36(35). Hyaline area apically in cell $1M_2$ of wing more or less surrounded by pigment extending from cell R_5 across cell M_1 into cell $2M_2$. Pigment extending from apex of cell R_1 across tip of cell R_{2+3} leaving a preapical hyaline spot in cell R_{2+3}; base of cell R_4 narrowly hyaline or subhyaline (Plate 4*k*). *West Indies* (Map 24).....***funebris*** Macquart

Hyaline area apically in cell $1M_2$ open posteriorly and usually open apically, if pigment extends from R_5 into cell M_1, then pigment not extending from tip of cell R_1 across apex of cell R_{2+3}; base of cell R_4 not narrowly hyaline or subhyaline (Plate 3*d–e*). (Males from West Indies, see *funebris* Macquart). Coastal plain of southeastern United States, north as far as New York, and west as far as Alabama.....***analis***, f. ***cedens*** Walker

37(34). Pigment on wing extending into cell $2M_2$ less than length of r-m crossvein; usually one-half or less of cell $1M_2$ pigmented; cell R_5 usually pigmented as far as base of cell M_1; pigment dark brown to velvet black (Plate 4*i*). Mesonotum, scutellum, and abdominal terga usually velvet black pollinose. Abdominal terga six and seven of male without silver scales. Tropical forest in rocky hills and mountainous areas from southern Mexico into northwestern South America, and in the Serra do Mar along the southeast coast of Brazil (Map 23).....38

Pigment on wing extending into cell $2M_2$ more than length of r-m crossvein; usually three-fifths or more of cell $1M_2$ pigmented; cell R_5 not pigmented as far as base of cell M_1 or, if so, then cell $1M_2$ more than two-thirds pigmented; pigment light brown to dark brown (Plate 3*a*). Mesonotum, scutellum, and terga brownish pollinose. Terga six and seven usually with overlapping silver scales. Sandy areas from southern Canada to Central America (Map 24).....***analis*** Say (typical)

38(37). Cell R_5 of wing pigmented along posterior margin for twice length of r-m crossvein beyond base of cell M_1. Colombia and Venezuela....***gideon***, f. ***propinquus*** (Schiner)

Cell R_5 of wing pigmented along posterior margin for length of r-m crossvein or less beyond base of cell M_1 (Plate 4*i*).....***gideon*** Fabricius (typical)

39(33). Cell R_1 of wing entirely pigmented (Plate 4*h*). Body with numerous gold and dark yellow scales and pile. Femora orange. São Paulo, southern Minas Gerais and northwestern Paraná in Brazil to northern Argentina.....***clinopictus***, new species

Cell R_1 of wing hyaline apically (Plate 4*j*) or, if pigmented, then body without yellow or gold scales, or femora black or dark red. Rio Grande do Sul in Brazil into Central America and south along west side of Andes into Ecuador and Peru (Map 22).....***repertus*** Walker

Anthrax argentatus (Cole)

Spongostylum argentatum Cole.—Cole and Lovett, 1919, p. 227 [*Spogostylum*].—Cole and Lovett, 1921, p. 244 [*Spogostylum*].
Anthrax argentatus.—Maughan, 1935, p. 32 [*argentatum*].

MALE.—Integument generally black; brown to gray pruinose; tibiae, proximal tarsal segments, and genitalia reddish. Front covered with coarse black setae and linear black scales; a few white scales usually present ventrolaterally. Face bare just below antennae, with coarse black setae and a few linear white scales on lower two-thirds; oral margin with linear and lanceolate yellowish-white scales laterally. Occiput with sparse, short black setae and sparse, linear black scales. Fringe of pile on posterior margin of occiput black. Second antennal segment rounded or with a sharp ridge apically; base of third segment hemispherical, slightly flattened; styliform portion and style slightly shorter than first two segments (Figure 102).

Scales on mesonotum linear, mostly black; some curly, white or yellowish-brown scales laterally and on humeral and postalar calli. Scales on pleura black, a few yellow and white scales sometimes on sternopleuron; scales on coxae black, yellow, and white. Postalar tuft of pile and that on prosternum, propleuron, and anterior margin of mesonotum black; a few white hairs intermixed, especially on mesonotum. Scutellum with linear and lanceolate, mostly black scales; white scales on posterior margin and laterally on anterior margin.

Wing (Plate 3*f*) translucent brown basally, hyaline apically, the color filling cell C, all except the apex of Sc, the basal half of R, the extreme bases of R_{2+3} and R_5, the basal third of $1M_2$, the extreme base of $2M_2$ and Cu_1 and all but the extreme apices of 1A and 2A. Stigmatic area anterodistally in cell 2M not pigmented. Calypter not pigmented, fringe of pile black. Alula well developed, posterior margin rounded.

Scales on femora lanceolate and ovate-truncate, black; a few white ones sometimes posteriorly on fore and middle pairs; scales on tibiae linear, black. Middle and hind femora with four to six setae anteroventrally.

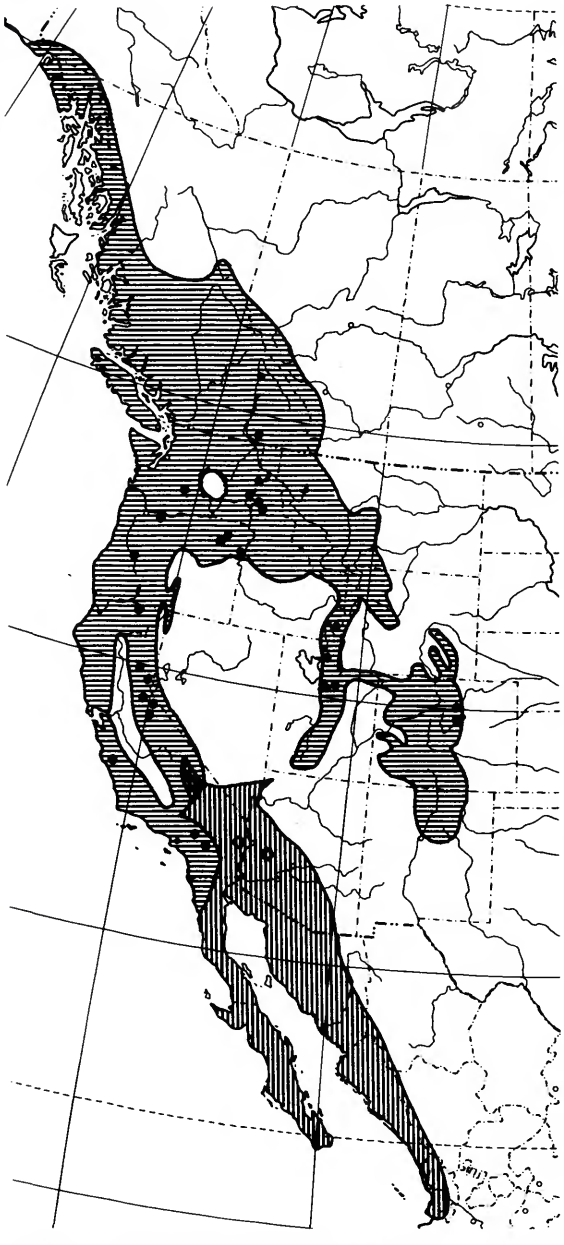
Pile on lateral margins of first abdominal tergum white, a few brown or black hairs posteriorly; lateral margins of second, third, fourth, and fifth segments with dense black hairs, setae and erect linear scales. Terga two, three, four, and anterior half of five with linear and lanceolate black scales except for small submedial patches of lanceolate white scales and large lateral patches of ovate-truncate, silvery-white scales on posterior margins of two and three; posterior half of fifth, and sixth and seventh sloping ventrally on each side of meson at a 45° angle, covered with dense, overlapping, elongate-truncate, laterally projecting silver scales except for a few lanceolate black scales and black setae medially on six and seven, and on medial half of five. Abdominal sterna with lanceolate scales except for some lanceolate-truncate, white or yellow scales along posterior margins.

MALE GENITALIA (Figure 50).—Gonocoxites short and broad, upper margin rounding to lower margin apically in lateral view; apices rounded and slightly emarginate medially in ventral view, with sparse, evenly distributed setae extending two-thirds of way to base. Basal segment of gonostylus convex dorsally, extending to base of distal segment; distal segment with a flat footlike part slightly emarginate apically, from which a curved, styliform part arises dorsomedially; footlike part with fine setae. Apex of epiphallus with a triangular, acuminate dorsal process extending slightly basad; apically rounded ventrolateral parts. Dorsal bands of epiphallus joined medially, without setae. Base of aedeagus large, bulbous, tapering to junction with ventral bands slightly before junction of dorsal bands.

FEMALE.—Similar to male. Only a few white scales laterally on six and seventh abdominal terga. Middle and hind femora sometimes with only three macrochaetae anteroventrally. Fore and middle tibiae with white scales posteriorly.

FEMALE GENITALIA (Figure 84).—Tenth tergum with 10 spines on each side. Ventral arm of ninth tergum narrow, slightly expanded and unequally bilobed apically. Dorsomedial angle of sclerite on each side of gonopore not greatly produced, bent interiorly; lateral arm formed in same plane as dorsomedial angle, slightly bent upward and truncate apically; ventral arm narrow, parallel sided and bent sharply mesad ventrally. Spermathecal ducts about two-thirds as long as bulbs, strongly contorted just before joining bulbs; middle section about twice as long as basal section, slightly shorter than apical section before contortions; bulbs of spermathecae elongate, tubular, tapering at base, slightly narrowed to apical "nipples" which are one-fifth as long as base.

DISTRIBUTION.—*Anthrax argentatus* occurs in mountainous areas from southern California north into British Columbia and south in the Rocky Mountains into Colorado (Map 11). It is generally allopat-



MAP 11.—Distribution of *Anthrax argentatus* (horizontal lines) and *A. nitidus* (vertical lines).

ric to *A. nitidus* Marston in southern California, although the two species were collected together at Surprise Canyon in the Panamint Mountains, Inyo Co., California.

TYPES.—The holotype and allotype are in the collection of the California Academy of Sciences. The type-locality is Hood River, Oregon. Two paratypes have been seen by the author.

DISCUSSION.—*Anthrax argentatus* appears to be most closely related to *nitidus*, to which it is allied by the structure of the antennae and male genitalia, and the chaetotaxy of the legs. The two may be readily distinguished by the wing pattern. In the past, *argentatus* often has been confused with *analis*. Besides the characters listed in the key, *analis* differs in having only one or two weak macrochaetae anteroventrally on the middle and hind femora, rather than four to six strong ones.

Anthrax nitidus, new species

MALE.—Integument black, shining under thin gray and brown pruinosity; margins of eyes and lower part of occiput white pruinose. Front and face with black setae, extending almost to antennae on latter. Occiput with black setae; fringe of pile on posterior margin black, a few white hairs behind vertex. First antennal segment much shorter than apical width, surrounding base of second segment; second segment lenticular; base of third segment flattened laterally, narrowing abruptly to styliform part; styliform part about 1.5 times longer than base, about 3 times longer than very short style. (Figure 101).

Mesonotum and scutellum with fine black setae and linear black scales; some linear white scales laterally on mesonotum. Sternopleuron, mesopleuron, and anterior half of pteropleuron with black setae and sparse, linear white scales, some black scales on last two. Prosternum and propleuron with black pile; anterior margin of mesonotum with mixed black and white pile; postalar tuft of pile black, Hypopleuron and metapleuron bare. Coxae with black bristles and mixed black and white, linear scales.

Wing (Plate 3*j*) translucent, light brown basally, hyaline apically; pigment filling cells C and Sc (subhyaline apically) and basal part of wing from vein R_1 above r–m crossvein across bases of cells R_{2+3}, R_5, $1M_2$, and Cu_1; pigment fading apically and posteriorly in cells 1A and 2A. Base of cell R_4 angled, not spurred; r–m crossvein at basal fourth of cell $1M_2$; vein R_{2+3} arising slightly basad of r–m crossvein; contact of cells $1M_2$ and Cu_1 about 1.5 times width of base of cell Cu_1. Cell 1A punctiform at margin. Posterobasal part of wing enlarged, cell 2A distinctly wider than cell 1A;

alula rounded posteriorly. Stigmatic area unpigmented. Calypter unpigmented, fringe of hairs white. Halter yellow, knob yellow.

Scales on legs black. Middle femur with three macrochaetae anteroventrally; hind femur with five or six macrochaetae anteroventrally. Fore tibia without macrochaetae anterodorsally; hind tibia with single row of macrochaetae anterodorsally.

First abdominal tergum with white pile laterally; posterior terga with sparse black setae and hairs laterally. Posterior margin of first tergum and discs of two through four with linear black scales; posterior margin of second tergum and lateral part of posterior margin of third tergum with linear white scales. Fifth tergum mostly with linear black scales, some lanceolate white scales posterolaterally; terga six and seven with linear black scales medially and lanceolate white scales laterally. Venter with sparse, fine, black setae.

MALE GENITALIA (Figure 51).—Gonocoxites very broad, dorsal margin falling almost at a right angle to ventral margin in lateral view; apices broadly rounded in ventral view; mesal margins bluntly angled, medial sulcus narrow; setae sparse, evenly distributed three-fourths of way to base. Basal segment of gonostylus slightly convex in lateral view, with a few fine setae apically. Distal segment of gonostylus oval in cross section basally, somewhat flattened dorsoventrally; styliform part arising from dorsomedial margin and extending upward and outward, apex slightly curved dorsally; base with sparse, short setae. Apex of epiphallus with a sharp dorsal projection and a sharp, slightly recurved flange on each side. Dorsal bands of epiphallus not joined medially, without setae. Base of aedeagus broad, bulbous with upper margin curving downward and apically to junction with ventral bands before approximation of dorsal bands; ventral bands with a pouchlike protuberance halfway to apex.

FEMALE.—Similar to male. Seventh abdominal tergum without white scales.

VARIATION.—The contact of cells $1M_2$ and Cu_1 may be as much as twice the width of the base of cell Cu_1. Cell 1A may be slightly open or closed and short petiolate. The postalar tuft of pile may be black or yellow.

DISTRIBUTION.—The few specimens available of *A. nitidus* indicate that the species occurs in desert areas in southern California and western Arizona. Its range probably also includes Sonora and Baja California (Map 11).

369-673 O—70——4

HOLOTYPE.—♂, Surprise Canyon, Panamint Mts., Inyo Co., California, IV-24-1957 (P. D. Hurd) (UCAL).

ALLOTYPE.—♀, 10 mi. W Blythe, Riverside Co., California, X-2-1954 (J. C. Hall) (UCAL).

PARATYPES.—Arizona: ♂; "Palm Canal," V-29-1955 (G. D. Butler and D. Tuttle) (ARIZ).

California: *Inyo Co.*, ♂, Surprise Canyon, Panamit Mts., IV-24-1957 (P. D. Hurd) (NLM).

DISCUSSION.—Structure of the male genitalia indicates that the closest relative to *nitidus* is *argentatus*. These two species seem to have no other close relatives in North and South America. *Anthrax nitidus* is unique among the species of *Anthrax* in North and South America in having the integument shining black. In this respect it closely resembles certain species of *Aphoebantus* occurring in southwestern United States.

Anthrax luctuosus Macquart

Anthrax luctuosus Macquart, 1840, p. 70 [*luctuosa*].—Paramonov, 1947, p. 95.

Argyramoeba luctuosa.—Schiner, 1868, p. 123 [*Argyromoeba*].—Kertész, 1909, p. 65.

MALE.—Integument mostly black; femora, trochanters, tibiae, metapleura, lateral margins of abdominal terga, and abdominal sterna yellow; discs of mesonotum, scutellum, and abdominal terga velvety black pruinose; face, lateral margins of front, and lower part of occiput silver pruinose; remainder of integument grayish or brownish pruinose. Front with fine, black setae and sparse linear black scales; face with dense, white setae extending to antennae and a few black setae. Occiput with short setae, white below, black above, and a few linear, recumbent black scales; fringe of pile on posterior margin white on lower two-thirds, yellowish white on upper third. First antennal segment about as long as wide; second segment globular, subequal in diameter to first segment and basal part of third segment; basal part of third segment flattened laterally, tapering gradually to styliform part; styliform part about three times as long as style (Figure 99).

Discs of mesonotum and scutellum with sparse, fine black setae and linear, recumbent black scales; lateral margins with linear, woolly scales, white anteriorly, black posteriorly, and brown medially. Pile, scales, and setae on mesopleuron and sternopleuron white; black setae and hairs sometimes present. Pile on propleuron, prosternum, and anterior margin of mesonotum white.

Pteropleuron with white or mixed black and white setae and scales anteriorly, with woolly, linear, gold or yellowish-white scales posteriorly. Fore coxa with white setae and scales; middle and hind coxae with coarse, white or mixed black and white setae and scales. Postalar tuft of pile black. A tuft of white hairs behind spiracle on metapleuron. Hypopleuron bare.

Wing (Plate 4*l*) hyaline apically, velvet black basally out to a line perpendicular to wing axis running from tips of cells 1A and 2A through extreme bases of cells R_{2+3} and R_5 to vein R_1 and slightly further apically in cells Sc and C. Cells C and Sc yellowish beyond margin of black. R–m crossvein at basal one-fifth to one-third of vein M_{1+2}. Contact of cells $1M_2$ and Cu_1 less than half of width of base of cell Cu_1. Cell 1A closed at wing margin. Cell 2A enlarged posteriorly, more than 1.5 times as wide as cell 1A. Stigmatic areas in cell M pigmented. Alula well developed, posterior margin slightly convex. Calypter pigmented, fringe of hairs light brown. Stem of halter reddish brown, knob yellow.

Scales on femora and tibiae black. Middle femur without distinct bristles anteroventrally; hind femur with three to five short bristles anteroventrally. Hind tibia with a single row of macrochaetae anterodorsally.

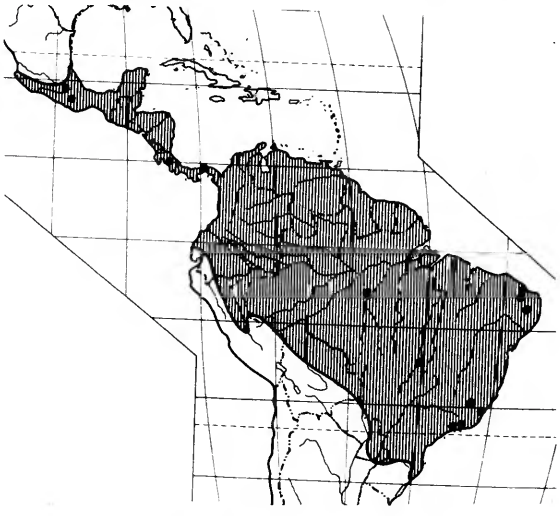
Lateral margins of first abdominal tergum with dense, silvery-white pile; pile on sides of second to fourth terga brown, black, or mixed. Posterior margin of first tergum with a dense patch of lanceolate, truncate, medially-directed, silvery-white scales laterally. Discs of terga two, three, and four, mesal half of posterior margin of first tergum, and mesal half of fifth tergum with sparse, fine black setae and linear, recumbent black scales. Lateral parts of fifth tergum and all of terga six and seven with dense, overlapping, truncate, posterolaterally directed, silvery-white scales. Venter with sparse, fine white setae and linear scales.

Male genitalia (Figure 54).—Gonocoxites broad, dorsal margin attenuating abruptly to sharply rounded tips in lateral view, mesal margins curving outward and recurving inward to widely separated, sharply rounded apices in ventral view; a few setae toward the base and some scattered setae apically. Basal segment of gonostylus convex dorsally, not extending past distal segment in ventral view; distal segment with an acuminate ventral lobe from which the structure curves upward and curls over dorsally. Apex of epiphallus narrow, with an acuminate, nearly vertical dorsal spine and ventrolateral lobes rounded apically in lateral view; dorsal bands narrowly separated mesally. Base of aedeagus narrow, gradually tapering to junction with ventral bands below approximation of dorsal bands.

Female.—Similar to male. Posterolateral margins of terga five and six with overlapping, truncate, silver scales, and white setae; remainder of posterior terga with black setae and scales. Sterna with black, white, or mixed black and white setae and scales.

Female genitalia (Figure 81).—Tenth tergum with about 14 spines. Ventral arm of ninth tergum narrow, parallel sided, not enlarged apically. Dorsomedial angle of sclerite on each side of gonopore extending mesally as a short, broadly rounded lobe as wide as lateral arm; lateral arm parallel sided, slightly enlarged at obtusely angular apex; ventral arm broadened medially parallel to meson, straight and narrow in dorsointerior view. Spermathecal ducts about twice as long as bulb; first and second sections short, about equal in length; third section about as long as basal two; second divisional collar enlarged, about twice as wide as first; bulb globoid, symmetrical, slightly longer than wide.

Distribution.—Specimens of *A. luctuosus* have been collected from southern Mexico through the Amazon Basin into southeastern Brazil (Map 12).



Map 12.—Distribution of *Anthrax luctuosus*.

This is one of the few species that seems to be adapted to areas of tropical or equatorial forest as well as desert areas.

Type.—According to Painter (personal notes) the type female of *A. luctuosus* is in the Paris Museum. It is headless, mostly denuded, and has only part of one

hind leg present. It carries the green museum label "*A. luctuosa* Macqt. Cayenne" and "1610," and pin labels "No. 898 *Anthrax luctuosa*" and "128, 38."

Although Macquart wrote "Patrie inconnue," in his personal copy in the Paris Museum this has been crossed out with "Cayenne" written in. Thus, the type-locality is probably Cayenne, French Guiana.

DISCUSSION.—Only one male has been found among the 27 specimens of this species available for study. A female from Pambal, Paraiba, Brazil, differs from the normal type in having the scales and hairs on the body almost entirely light yellow.

Characters for the separation of *luctuosus* from *cathetodaithmos* and other species in the *cephus* group are given under *cathetodaithmos*.

Anthrax cathetodaithmos, new species

FEMALE.—Body black, legs reddish; integument brown and velvet-black pruinose. Setae on front black; scales lanceolate, black above, mixed black and yellowish white below. Setae on face extending almost to antennae, yellowish white below, mixed yellowish white and black above. Setae on occiput black, fringe of hairs on posterior margin black. First antennal segment about as long as apical width; second segment globular, about as wide as first segment; base of third segment compressed laterally, narrowing abruptly to styliform part, styliform part slightly longer than base, about twice as long as style (Figure 99).

Scales, setae, and pile on mesonotum and scutellum black. Mesopleuron and sternopleuron with black hairs, setae, and scales; anterior half of pteropleuron with mixed black and yellowish-white setae and hairs, posterior half bare; hypopleuron and metapleuron bare. Pile on prosternum, propleuron, and anterior margin of mesonotum black. Postalar tuft of pile black. Setae and scales on coxae black.

Wing (Plate 4*l*) dark brown basally, hyaline apically, pigment margin running perpendicularly to wing axis from tip of vein 2A to anterior margin slightly beyond r–m crossvein; apices of cells C and Sc not pigmented, disc of cell 2A hyaline. Stigmatic area not pigmented. Base of cell R_4 without a spur, base of cell R_{2+3} with a short spur. R–m crossvein at basal fourth of cell $1M_2$; contact of cells M_{1+2} and Cu_1 less than half as long as base of cell Cu_1. Cell 1A as broad as cell M; cell 2A greatly broadened, about 1.5 times wider than cell 1A medially; alula well developed, posterior margin slightly convex. Calypter pigmented dark brown, fringe of hair brown. Stem of halter light brown, extreme base of knob brown, remainder yellow.

Scales on fore and middle femora black, on hind femur and tibia mixed black and white. Middle femur without macrochaetae; hind femur with four weak macrochaetae anteroventrally. Hind tibia with a single row of macrochaetae anterodorsally.

First abdominal tergum with black pile laterally; lateral margins of terga two through four with mixed black and yellowish-white pile and setae, the black predominating anteriorly; lateral margins of terga five and six with yellowish-white pile and setae; seventh tergum with black setae. Linear scales on posterior margin of first tergum and on second tergum black; scales on posterior terga black medially and anteriorly, yellowish white posteriorly and laterally, the area of black scales decreasing posteriorly. Setae and scales on venter mostly white, some black setae present medially on first tergum.

FEMALE GENITALIA (Figure 80).—Tenth tergum with 16 spines on each side. Ventral arm of ninth tergum broad basally, narrow apically, apex not enlarged. Dorsomedial angle of sclerite on each side of gonopore projecting dorsomedially as a short, sharply rounded lobe; lateral arm widened to middle, falling obliquely to sharp ventroapical angle; ventral arm narrow, parallel sided, bending slightly inward at apex. Ducts of spermathecae about 3 times longer than bulbs; first section very short; second section about two-thirds as long as third which is about 1.5 times longer than bulb and gradually expanded apically; bulb globoid, symmetrical, but distinctly broader than long.

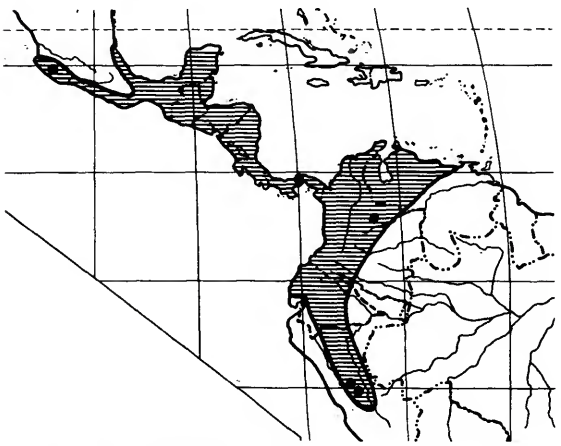
MALE.—Similar to female. Setae on face entirely black. Pile and scales on thorax entirely black. Pile and scales on abdomen entirely black.

MALE GENITALIA (Figure 53).—Gonocoxites broad basally, dorsal margins attenuating abruptly to sharply rounded tips in lateral view; mesal margins curving outward and recurving slightly inward to broadly separated, sharply rounded tips in ventral view; fine setae along mesal margins apically, coarse setae scattered over remainder. Basal segment of gonostylus not evident in lateral view, tip sharply rounded in ventral view; distal segment of gonostylus with a sharp, laterally produced spine arising from a knoblike apex above a constricted medial portion. Apex of epiphallus narrow in dorsal view, with a sharp, nearly vertical dorsal spine; ventrolateral part rounded apically, not projecting beyond apex of aedeagus; base of aedeagus broad, tapering to junction with ventral bands below

approximation of dorsal bands; dorsal bands narrowly separated almost to dorsal spine.

VARIATION.—The pile on the face, prosternum, propleuron, anterior margin of mesonotum, and lateral margins of the first abdominal tergum may be entirely black or predominantly white. The scales on the hind tibia and femur may be entirely black or mixed black and white. The scales on the posterior abdominal terga may be entirely black, partly yellowish white, or in patches of silver laterally on terga five and six. The scales on the abdominal sterna may be black or predominantly white.

DISTRIBUTION.—*Anthrax cathetodaithmos* apparently occurs in mountainous areas covered with tropical forest from Peru to southwestern Mexico (Map 13). It is sympatric to *luctuosus*, however, which



MAP 13.—Distribution of *Anthrax cathetodaithmos*.

occurs eastward into the Amazon Basin and southeastern Brazil. Further collecting may show that *cathetodaithmos* occurs in more rocky terrain and perhaps at greater altitude.

HOLOTYPE.—♀, 3 mi. E Colima, Colima, Mexico, VIII-27-1962, 1100 feet (R. H. and E. M. Painter), "hovering over *Bembex* nesting place near Punte el Saldo" (RHP).

ALLOTYPE.—♂, 75 mi. E Tingo Maria, Huanuco, Peru, X-4-1954 (E. I. Schlinger and E. S. Ross) (CAS).

PARATYPES.—Colombia: *Boyaca*, 2♂, Muzo, VI, VII-1936, 900 m (J. Bequaert) (NLM, MCZ).

Panama: ♀, Bella Vista, III-23-1926 (C. T. Greene) (AMNH); ♂, "Sabanas," XI-17-1923, F4860 (AMNH).

Peru: *Pasco*, ♀, Puerto Bermudez, Rio Pichis, VII-18-1920 (AMNH).

DISCUSSION.—*Anthrax cathetodaithmos*, although very closely related to *luctuosus*, may be readily distinguished by the absence of woolly, linear scales on the posterior part of the pteropleuron. It also differs in having the pile and scales on the anterior pleura black rather than white, in having the setae and scales on the anterior coxa black rather than white, in lacking silver scales laterally on the first abdominal tergum, and in having the fringe of pile on the posterior margin of the occiput black rather than white.

The variation shown among the few specimens of *cathetodaithmos* and *luctuosus* may indicate that additional species are included in this complex.

Anthrax luctuosus and *cathetodaithmos* may be readily separated from the other species in the *cephus* group by their distinctive wing pattern in which the apical margin is perpendicular to the axis of the wing and the apices of cells C and Sc are not pigmented.

Anthrax hylaios, new species

MALE.—Legs, coxae, lower half of pleura except lower half of sternopleuron, underturned edges of abdominal terga, abdominal sterna, genitalia, and first antennal segment orange, remainder of body black; dark area of integument grayish or brownish pruinose, margins of eyes silver pruinose. Front with black setae and lanceolate black scales, some white scales laterally below; face with black setae extending almost to antennae, some white hairs and setae below. Occiput with black setae and sparse, linear black scales; fringe of hairs on posterior margin black exteriorly and yellow interiorly above, becoming white below. First antennal segment about as long as apical width; second segment globoid, somewhat flattened distally and somewhat inserted in apex of first segment; basal part of third segment slightly broader than second segment, flattened mesolaterally, tapering gradually to styliform part which is about as long as base and slightly longer than style (Figure 103).

Anterior part of mesonotum and posterior edge with fine black setae and mixed golden-brown and black, linear scales; posterior half of mesonotum and disc of scutellum with linear black scales; lateral margins of mesonotum and posterior margin of scutellum with golden-brown scales. Sternopleuron and anterior half of pteropleuron with fine black setae and linear yellow scales; mesopleuron with fine black setae, white pile,

and linear scales, some golden-brown hairs posterodorsally; prosternum, propleuron, and anterior margin of mesonotum with white pile, some black setae on latter; postalar tuft of pile black. Fore coxa with black setae and white, linear and lanceolate scales; middle and hind coxae with black setae and mixed black and white scales. Hypopleuron and metapleuron bare.

Pigment of wing (Plate 4*g*) dark brown, filling all except extreme tip of cell R_1 and extending from apex of cell R_1 across cell R_{2+3} to medial angle of vein R_4; cell R_{2+3} and cell R_5 pigmented basally two-thirds of distance to base of cell R_4, a narrow hyaline area along posterior margin of cell R_5; basal one-fourth of cell $1M_2$ and extreme base of cell Cu_1 pigmented; cells 1A and 2A hyaline apically for twice width of r–m crossvein. Base of vein R_4 angular; r–m crossvein located at basal third of cell $1M_2$, base of vein R_{2+3} located opposite r–m crossvein; contact of cells $2M_2$ and Cu_1 about equal to width of base of cell Cu_1; apex of cell 1A punctiform. Posterior margin of alula rounded. Stigmatic area pigmented; calypter pigmented, fringe of hairs yellowish white. Halter light brown, knob light brown basally and yellow apically above, yellow below.

Fore and middle femora with light-brown scales anterodorsally and light-yellow scales posteroventrally; fore and middle tibiae with light-yellow scales posteriorly and light-brown scales anteriorly; scales on hind femur and tibia mostly brown. Middle femur with one or two macrochaetae anteroventrally; posterior femur with an incomplete row of macrochaetae anteroventrally; anterodorsal surface of fore tibia with macrochaetae apically; hind tibia with single row of macrochaetae anterodorsally.

First abdominal tergum with white setae laterally; lateral margins of terga two through four with dense black pile and erect, linear scales above with sparse yellow hairs below; fifth, sixth, and seventh terga with long, overlapping, lanceolate-truncate, yellowish-white scales above and sparse yellow hairs below, some black hairs present above on anterior part of five. Posterior margin of first tergum and discs of other terga with fine black setae and linear black scales, some linear gold scales on posterior margin of terga one, two, five, and six. Abdominal sterna with sparse black and yellow setae and sparse, linear yellow scales.

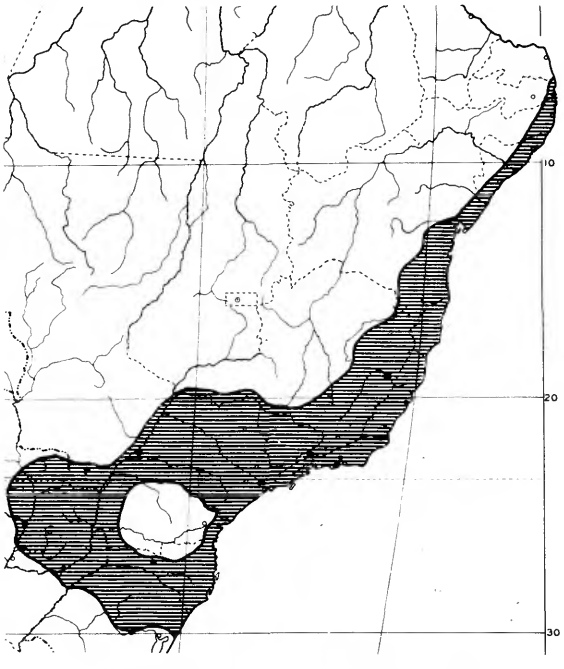
Male genitalia (Figure 52).—Gonocoxites broad, undulating ventrally in lateral view, dorsal margins straight, tapering to sharply rounded apices; apices with sharp lateral angles, with sharp mesal ridges and a broad medial sulcus in ventral view; setae present on apical third, densest in a basomedial tuft. Basal segment of gonostylus convex dorsally in lateral view, with a narrow, truncate basal lobe dorsally; apex angled, with fringe of setae. Distal segment formed upright, with broad distobasal lobe covered with dense, coarse setae; apex with distal flattened area with sharp tooth interiorly, and with sharp ridge basally. Apex of epiphallus flattened, with narrow, apically truncate medial part with sharp, basally directed medial spine basally; lateral part curved downward laterally and apically, apex broadly rounded in lateral view, sharply rounded in dorsal view; apex of epiphallus connected to aedeagus by transverse, flexible band. Dorsal bands narrow, united medially, without setae. Aedeagus narrow basally, tapering irregularly to junction with ventral bands beyond junction of dorsal bands.

Female.—Similar to male. Setae on lower half of face mixed black and white. Base of third antennal segment distinctly wider than second segment in lateral view. Hairs and setae on sternopleuron and pteropleuron mostly white. Pigment of wing filling base of cell Cu_1 and all of cells 1A and 2A except extreme apices. Silver scales on abdominal terga restricted to sides of sixth tergum. Abdominal sterna with black setae and brown scales.

Female genitalia (Figure 79).—Tenth tergum with 19 spines on each side. Ventral arm of ninth tergum enlarged apically and bent mesointeriorly at almost a right angle. Dorsomedial angle of sclerite on each side of gonopore curved upward and mesally as a broad, rounded lobe; lateral arm curved upward and rounded apically in dorsointerior view, forming a broad plate emarginate apically and rounded laterally in ventral view; ventral arm expanded parallel to meson, acuminate apically. Ducts of spermathecae about 3 times as long as bulbs; first section short, about half as long as third section; second section about 4 times as long as third section which is about two-thirds as long as bulb and slightly expanded at extreme apex; bulb globoid, about 1.5 times longer than wide and tapered to junction with duct.

Variation.—The specimens examined show little variation from the holotype and allotype. The setae on the face may be white, black, or mixed. The first antennal segment may be orange or dark brown. The setae on the lower pleura may be either white or black in the male.

DISTRIBUTION.—*Anthrax hylaios* occurs in tropical forests in the Serra do Mar of eastern Brazil, and in lowland areas in southern Brazil and southeastern Paraguay (Map 14).



MAP 14.—Distribution of *Anthrax hylaios*.

HOLOTYPE.—♂, Itatiaya, Estado de Rio de Janeiro, Brazil, X–16–1949, 700 m (W. Zikán) (IOC).

ALLOTYPE.—♀, Itatiaya, Estado de Rio de Janeiro, Brazil, VII–3–1935, 700 m (J. F. Zikán) (IOC).

PARATYPES.—Brazil: *Guanabara,* ♀, Rio de Janeiro, XI–28–1933 (Dr. Zikán) (IOC); ♀, Rio de Janeiro, XI–10–1936 (Dr. Zikán) (NLM). *Mato Grosso,* ♂, Maracajú, VII–1937 (Servicio Febre Amarela, M.E.S., Brazil) (SASP). *Minas Gerais,* ♀, Calado, Rio Doce, II–12–15–1939 (Martins and Lopes) (IOC). *Rio de Janeiro,* ♀, Grajahú, VIII–20–1939 (S. Lopes) (IOC); ♀, Itatiaya, 700 m, II–19–1945 (J. F. Zikán) (IOC); ♀, Itatiaya, 700 m, III–18–1945 (J. F. Zikán) (IOC); ♀, Itatiaya, 700 m, II–7–1947 (J. F. Zikán) (IOC). *Santa Catarina,* ♂, Nova Teutonia, 27°11′ S, 52°23′ E, XI–29–1938 (Fritz Plaumann) (BM). *São Paulo,* ♀, Porto Cabral, Rio Paraná, X–6–15–1941 (L. Travassos Filho) (SASP); ♀, Porto Cabral, Rio Paraná, XI–1–10–1941 (L. Travassos Filho) (NLM).

OTHER MATERIAL EXAMINED.—Brazil: *Rio de Janeiro,* ♀, Itatiaya, 700 m, XI–27–1953 (J. F. Zikán).

DISCUSSION.—There appear to be no close relatives to *hylaios* in either North or South America. The distinctive wing pattern will serve to separate it from other species.

Anthrax xanthomeros, new species

FEMALE.—Body mostly black, femora, tibiae, apices of abdominal sterna, and lateral margins of terga orange; integument mostly brown and gray pruinose, margins of eyes and lower two-thirds of occiput silver pruinose. Front with black setae and lanceolate black scales; face with white setae extending almost to antennae. Setae on occiput black on upper third, white below; fringe of hairs on posterior margin black exteriorly and white interiorly on upper third, white below. First antennal segment about as long as apical width; second segment lenticular; base of third segment flattened mesolaterally, distinctly wider than second segment, tapering gradually to styliform part which is shorter than basal part and slightly longer than style.

Mesonotum with linear, rusty-brown scales laterally and anteriorly, extending inward from in front of base of wings, extending backward submedially from anterior margin, and extending forward in a triangle from posterior margin; scutellum with linear rusty-brown scales on posterior margin, some lanceolate yellow scales medially; remainder of mesonotum and scutellum with linear black scales. Sternopleuron with fine white setae and linear white and yellow scales; ventral and posterior parts of mesopleuron and anterior half of pteropleuron with fine white setae and linear gold scales, some coarse black setae above. Prosternum, propleuron, anterodorsal part of mesopleuron, and anterior margin of mesonotum with white pile; postalar tuft of pile mixed yellow and brown. Metapleuron with several white scales just above coxa; hypopleuron bare. Fore coxa with black and white setae and linear white scales; middle and hind coxae with black setae and mixed gold and white linear scales.

Wing (Plate 3*g*) light brown basally, hyaline apically; pigment filling most of cells C and Sc (apices subhyaline) and extending out to a line running from vein R_1 just beyond base of cell R_{2+3} to base of cell Cu_1 and thence basally, filling basal two-thirds of cell 1A and anterobasal fourth of cell 2A. Base of cell R_4 angled, with rudiment of spur; r–m crossvein arising at basal two-sevenths of cell $1M_2$; vein R_{2+3} arising slightly

basad of r–m crossvein; contact of cells $1M_2$ and Cu_1 about one-fourth longer than width of base of cell Cu_1; cell 2A broadly open. Stigmatic area broadly pigmented. Alula not narrowed, rounded posteriorly. Calypter lightly pigmented, fringe of hairs yellow and brown. Halter yellow, knob brown anterobasally, yellow elsewhere.

Scales on femora and fore and middle tibiae yellow, some black scales anteriorly at apex of fore and middle femora and apically on hind femur; hind tibia with black scales. Middle femur with five macrochaetae anteroventrally; hind femur with anteroventral row of macrochaetae incomplete basally; fore tibia with complete row of macrochaetae anterodorsally; hind tibia with single row of macrochaetae anterodorsally.

First abdominal tergum with yellowish-white pile laterally; posterior half of second tergum, and third and fourth terga with black pile laterally, anterior half of second tergum with linear rusty-brown scales. Posterior margin of first tergum with short, lanceolate white scales laterally and linear rusty-brown scales medially; discs of remaining terga mostly covered with linear black scales, posterior margins with linear rusty-brown scales. Venter with fine setae, yellow basally and black apically. First sternum, and anterior and lateral parts of second sternum with lanceolate white scales; middle of posterior margin of second sternum and remaining sterna with short, lanceolate-truncate, yellow scales.

DISTRIBUTION.—*Anthrax xanthomeros* is known from only the holotype, although it probably also occurs throughout northern Central America and into southern Mexico.

HOLOTYPE.—♀, Benque Viejo, British Honduras (Father Stanton) (MCZ). The type lacks one middle and one hind leg and the third segment of the left antenna. The head is covered with fungus.

DISCUSSION.—*Anthrax xanthomeros* has no close relatives in North and South America. It has in common with *hylaios* its orange femora, strong femoral macrochaetae, and antennal structure, but the distinctive wing pattern of *hylaios* clearly sets them apart. Species with a wing pattern similar to *xanthomeros* may be distinguished readily by their reddish-brown or black femora and by the lack of rusty-brown scales on the margins of the mesonotum and on abdominal terga two through seven.

Anthrax midas Fabricius

Anthrax midas Fabricius, 1805, p. 124.—Kertész, 1909, p. 46.
Anthrax guianicus Curran, 1934, p. 362 [*guianica*].
Anthrax mexicanus Cole, 1957, p. 202.

MALE.—Integument generally black; femora, tibiae, and sometimes pleura reddish brown; eye margins silver pruinose, remainder of body brown to gray pruinose. Front with black setae and scales; setae on face mostly black, a few white setae below. Occiput with short black setae and linear scales, black above, white below; fringe of pile on posterior margin black above, white below. First antennal segment about 1.5 times longer than its apical width; second segment globular; third segment flattened mesolaterally, tapering gradually from base to styliform part, styliform part about equal to base; style about two-thirds as long as styliform part (Figure 95).

Discs of mesonotum and scutellum with fine black setae and linear black scales; lateral margins with woolly black scales and coarse black setae. Sternopleuron, mesopleuron, and anterior half of pteropleuron with fine black setae and brown, white, or mixed, linear scales and hairs. Prosternum and propleuron with white or mixed brown and white pile; anterior margin of mesonotum with mixed black setae and white or brown and white pile; postalar tuft of pile black. Anteroventral corner of hypopleuron with some fine, black or white hairs; metapleuron sometimes with fine brown or white hairs extending from behind spiracle to coxa. Anterior coxa with fine, brown and white hairs and scales, and black setae. Middle and hind coxae with linear brown scales and black setae, a few white scales sometimes present.

Wing (Plate 4e) brown basally, hyaline apically; pigment fading apically. Pigment filling all of cells C and Sc, and extending out to a line curving from vein R_1 before tip of vein Sc through bases of cells R_{2+3}, R_5, and Cu_1 to tip of vein 2A. Stigmatic area lightly pigmented. Basal angle of vein R_{2+3} with short spur; basal angle of cell R_4 with long spur. R–m crossvein located at basal third of cell $1M_2$; contact of cells $1M_2$ and Cu_1 slightly longer than width of base of cell Cu_1. Wing not narrowed basally; cell 2A slightly wider than cell 1A. Calypter pigmented, fringe of hairs brown. Alula rounded posteriorly. Halter brownish black, knob yellow apically.

Scales on femora and tibiae entirely black, or posterior margins of fore and middle pairs with white scales; scales on hind tibia and basitarsus sometimes

semierect. Middle femur with four to seven macrochaetae anteroventrally; anterior side with one or more macrochaetae postmedially. Hind femur with a complete row of macrochaetae anteroventrally and partial rows posteroventrally and anterodorsally.

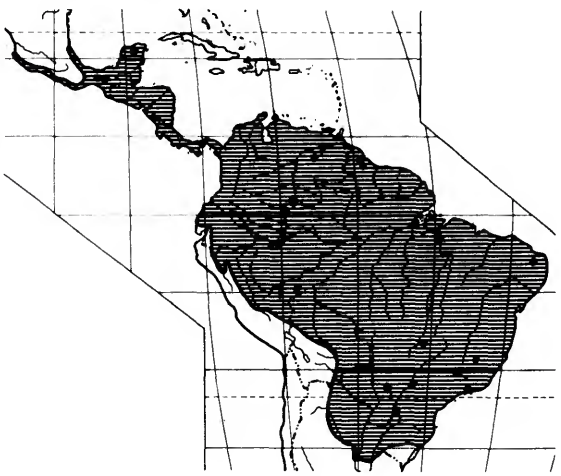
Lateral margins of first abdominal tergum with dense white pile, a few black setae and recumbent white scales sometimes present posteriorly; lateral margins of terga two through five with dense black pile and setae. Posterior margin of first tergum and discs of terga two through five with sparse, fine black setae and linear black scales. Terga six and seven and sometimes lateral margins of five with dense, overlapping, elongate, posteriorly projecting, silver scales. Venter with sparse white scales and fine setae, white anteriorly, black posteriorly.

Male genitalia (Figure 58).—Gonocoxites long and narrow, dorsal margins tapering gradually to ventral margins apically; apices narrowed in ventral view, infolded mesally to form flat lobelike structures; setae on gonocoxites evenly distributed basally beyond medial fold, apices bare. Basal segment of gonostylus oblong in lateral view, with dense tuft of setae internally at apex. Distal segment of gonostylus pyriform in ventral view, ovoid in lateral view, apex extending outward and downward; lateral and ventral surfaces with fine setae. Apex of epiphallus flattened dorsoventrally, apex broad and bluntly angled in dorsal view, short, sharp, recurved lobes present on each side midway between junction of dorsal bands and apex. Dorsal bands proximate mesally, with some setae before junction. Base of aedeagus narrow, tapering to junction with ventral bands before lateral lobes of epiphallus.

Female.—Similar to male. White scales more extensive on pleura and fore and middle femora. Fringe of hairs on calypter often white. Scales and setae on anterior sterna white, on posterior sterna black. Pigmentation of wing slightly more extensive, reaching base of cell $2M_2$. White scales on abdominal terga restricted to sides of five and six.

Female genitalia (Figure 76).—Tenth tergum with 21 spines on each side. Ventral arm of ninth tergum more or less parallel basally, irregularly margined, and slightly expanded distally. Dorsomedial angle of sclerite on each side of gonopore produced dorsally as short, sharply rounded lobe; lateral arm broad, parallel sided, and truncate distally, ventral arm broad, twisted parallel to meson, and slightly curved outward. Spermathecal ducts about as long as bulbs; first section very short; middle section about two-thirds as long as apical section which is about two-thirds as long as bulb and broadened apically; bulb elongate tubular, about 2.5 times longer than wide, tapering basally and with a slightly enlarged, darker apical part.

Distribution.—*Anthrax midas* occurs in equatorial and tropical forests from southern Mexico to southeastern Brazil (Map 15).



Map 15.—Distribution of *Anthrax midas*.

Types.—The holotype female of *Anthrax midas* Fabricius is in the Universitets Zoologiske Museum, Copenhagen, collection. According to Painter and Painter (unpublished notes) it is in fairly good condition although the antennae are missing. It carries the red type label and "*A. midas*, ex Am. Merid. Schmidt." A homotype has been seen by the author.

The types of *Anthrax guianicus* Curran are in the American Museum of Natural History. The holotype is lacking its head; the allotype lacks one wing, four legs and its abdomen, and has its head glued on. The paratype female is in excellent condition. Curran reversed the sexes in his description.

The types of *Anthrax mexicanus* Cole are in the collection of the University of California at Berkeley. A paratype male in excellent condition has been seen by the author.

Discussion.—The specimen which d'Andretta and Carrera (1952) referred to as *Anthrax leucopygus* Macquart, 1855 (not Macquart, 1840), and on which they based their new name, *macquarti*, has been seen by the author. The specimen belongs to *midas* rather than *leucopygus*.

Anthrax midas differs from *hyalacrus* in having the pile on the lateral margins of the first abdominal tergum white rather than black and in having the pile on the pleura white or brown rather than black. It differs from other species in the *cephus* complex in having the wings only one-half pigmented.

Anthrax hyalacrus Wiedemann

Anthrax hyalacrus Wiedemann, 1828, p. 315.
Anthrax acroleuca.—Curran, 1934, p. 363, [not Wiedemann, 1828].

MALE.—Integument black; velvety black pruinose on discs of mesonotum, scutellum, and abdominal terga; silvery pruinose along margins of eyes, grayish or brownish pruinose elsewhere. Setae and scales on front black; face with black setae above extending to bases of antennae, with black or mixed black and white setae below. Setae and scales on occiput and fringe of hairs on posterior margin black. First antennal segment about as long as apical width, second segment globular; third segment flattened mesolaterally, tapering gradually to styliform part; style about half as long as styliform part (Figure 98).

Setae, pile, and scales on thorax and coxae black. A few black hairs usually behind spiracle. Anterior corner of hypopleuron with a small patch of hairs.

Wing (Plate 4*f*) velvet black basally, hyaline apically. Pigment extending out to a line running from tip of cell Sc along vein R_1 to a point about halfway between bases of cells R_{2+3} and R_4 and thence posteriorly through base of cell $2M_2$ to tip of cell 1A. Veins in pigmented portion black, in hyaline portion light brown. Cell 2A slightly wider than cell 1A. Stigmatic area pigmented. Calypter pigmented, fringe of hairs black. Halter black with light-tipped knob.

Femora and tibiae with dense, black scales; hind femur, tibia, and tarsus sometimes with dense, overlapping, cuneate white scales. Middle femur with one or two large postmedial bristles anteriorly and up to three bristles anteroventrally; posterior femur with five to seven short bristles anteroventrally.

Pile and scales on first five abdominal terga black; pile dense laterally. Sixth and seventh terga and posterolateral margins of fifth with laterally produced, dense, overlapping, truncate silver scales, or silver scales restricted to posterolateral margins of sixth and seventh terga.

MALE GENITALIA (Figure 57).—Gonocoxites very narrow apically, tapering to acute apices in lateral view, apices sharply rounded and separated mesally by a distinct sulcus; setae on gonocoxites evenly distributed, extending beyond medial fold. Basal segment of gonostylus long and thin in lateral view, with a number of coarse setae apically; distal segment elongate, oval, basal part bent slightly outward dorsally, with fine setae laterally on lower two-thirds. Apex of epiphallus flattened dorsoventrally, with a recurved, sharp lobe on each side and a short, triangulate apical plate above apex of aedeagus. Dorsal bands narrow, widely separated medially, without setae. Aedeagus very broad and bulbous basally, tapering apically to junction with ventral bands before lobes of apex of epiphallus.

FEMALE.—Similar to male. Apical margin of pigment on wing sometimes running apically along vein R_{4+5} for a distance of half width of cell R_5. Posterior abdominal terga without silvery scales.

FEMALE GENITALIA (Figure 78).—Tenth tergum with about 31 spines on each side. Ventral arm of ninth tergum undulating, not enlarged apically. Dorsomedial angle of sclerite on each side of gonopore not produced, right angled; lateral arm narrow, not tapering, sharply rounded distally; ventral arm broadened parallel to meson and twisted. Spermathecal ducts about half as long as bulbs; first section very short; middle section about two-thirds as long as apical section which is about one-third as long as bulb, expanded apically and bent at almost a right angle medially; bulb elongate, tapering from apex to base, about three times longer than maximum width and with an enlarged, darker apical part.

DISTRIBUTION.—*Anthrax hyalacrus* occurs in equatorial and tropical forests from the Amazon Basin north into Panama and south into southern and eastern Brazil (Map 16).

TYPES.—Painter (unpublished notes) found two females of *Anthrax hyalacrus* at the Vienna Museum, one carrying the labels "Brasilia," "*hyalacra* Coll. Winthem" and "*hyalacra* Wied. Brasilia" in Wiedemann's handwriting, the other carrying the labels *hyalacra* Coll. Wiedem." and "*A. hyalacra* in Amer. mer. Brasil." Both specimens are abraded and the first lacks most of the antennae while the second is covered with fungus but has the left antenna complete. Because of the condition of the syntypes, no lectotype was chosen. A homotype compared by Painter leaves little doubt as to the identity of this species.

BIOLOGY.—Two specimens of *hyalacrus* were reared by Dr. Carl W. Rettenmeyer from nests of a Trypoxy-

MAP 16.—Distribution of *Anthrax hyalacrus*.

lonid wasp (Hymenoptera: Sphecidae) on Barro Colorado Island, Canal Zone. The wasps were nesting in a cardboard carton in a clearing at the Biological Station.

DISCUSSION.—One male from Rio Caiary-Uaupés, Amazonas, Brazil, has the lower two-thirds of the front covered with linear, semierect, white scales and white setae. The setae on the face are mixed black and white. This specimen also has the anterodorsal part of the hind legs covered with overlapping white scales. Other males with white scales on the hind legs are from Porto Cabral, São Paulo, Brazil, and Azupizú to Miriantiriañi, Cam. del Pichis, Peru. The specimens from São Paulo were collected with a male with only black scales on the legs.

Anthrax hyalacrus may be readily distinguished from *midas* by the entirely black pile on the pleura and first abdominal segment. It differs from *cephus* and *aterrimus* in having the apical half of the wing hyaline.

Anthrax cephus Fabricius

Anthrax cephus Fabricius, 1805, p. 124.—Wiedemann, 1828, p. 297.—Macquart, 1840, p. 59.—Walker 1849, p. 266.
Argyramoeba cephus.—Kertész, 1909, p. 62.

MALE.—Integument generally black; legs, pleura, and genitalia reddish brown; integument mostly grayish or brownish pruinose, margins of eyes and lower part of occiput silvery pruinose. Front with black setae and a few black scales below; face with black setae extending upward to antennae, a few white hairs and scales below. Scales and setae on occiput black; fringe of pile on posterior margin black above, white or mixed brown and white below. First antennal segment about as long as apical width; second segment globular; base of third segment flattened mesolaterally, tapering gradually to styliform part which is about equal to base; style one-half to three-fourths as long as styliform part.

Mesonotum and scutellum with fine black setae and linear black scales, sometimes brown or white scales in front of base of wings and white scales rarely present at apex of scutellum. Sternopleuron, mesopleuron, and anterior part of pteropleuron with fine black setae and black and/or white, threadlike scales; upper half of mesopleuron and pteropleuron with some coarse black setae and black and/or white pile. Pile on prosternum, propleuron, and anterior margin of mesonotum black, white, or mixed; postalar tuft of pile black. A few black or white hairs behind spiracle; anteroventral corner of hypopleuron with a few black or white hairs or threadlike scales. Fore coxa with black setae and black and/or white pile and scales; middle and hind coxae with black setae and black or mixed black and white scales.

Wing (Plate 4*c*) entirely black pigmented or subhyaline apically. Stigmatic area lightly pigmented; calypter pigmented, fringe of hairs brown. R-m crossvein located one-third or two-fifths of way from origin to bifurcation of vein M_{1+2}; contact of cells $1M_2$ and Cu_1 one to two times as long as base of cell Cu_1. Vein R_4 with long spur at base. Cell 2A as wide as cell 1A.

Scales on legs black. Middle femur with one to four macrochaetae anteroventrally and one to several macrochaetae postmedially on anterior side; hind femur with four to seven macrochaetae anteroventrally. Hind tibia with double row of macrochaetae anterodorsally; scales mostly recumbent.

Pile on lateral margins of first abdominal tergum white, sometimes a few black hairs posteriorly; lateral margins of terga two through four, and sometimes five and six with dense black pile. Posterior margins of first tergum, discs of terga two through four and sometimes five and six with sparse black setae and linear black scales. Seventh tergum and sometimes all or lateral parts of terga five and six with dense, overlapping, posteriorly-produced, silver-white scales. Setae and scales on sterna entirely black, or white (or yellow) anteriorly and black posteriorly.

MALE GENITALIA (Figure 59).—Gonocoxites long and narrow, narrowing abruptly before very narrow tips in lateral view, apices infolded mesally, forming narrow, acuminate, incurved lobes in ventral view, setae evenly distributed basally beyond medial fold, extreme apices bare. Basal segment of gonostylus oblong, with a few setae apically; distal segment bulbous in ventral view, with a diagonally truncate tip, dorsal margin tapering to ventral margin in lateral view; fine setae present on basal part. Apex of epiphallus flattened dorsoventrally, apex rounded, sharp, recurved lateral lobes present preapically. Dorsal bands narrow, proximate medially, with a few setae before junction. Base of aedeagus narrow, but bulbous, tapering to junction with ventral bands after junction of dorsal bands, with enlarged area before junction of dorsal bands.

FEMALE.—Similar to male. White pile and scales sometimes more extensive on pleura. Fore and middle femora and tibiae sometimes with white scales posteriorly. Hind femur sometimes with complete row of macrochaetae anteroventrally. Apex of wing sometimes hyaline as far back as a line running from tip of subcosta to tip of M_2 in specimens from Central America. Silver scales on apex of abdomen restricted to lateral parts of fifth tergum and sometimes to the sixth and seventh.

FEMALE GENITALIA (Figure 77).—Tenth tergum with about 21 spines on each side. Ventral arm of ninth tergum undulate, not expanded apically. Dorsomedial angle of sclerite on each side of gonopore produced dorsally as a short, rounded lobe about as long as broad; lateral arm short, broad, parallel sided and truncate apically; ventral arm broadened medially parallel to meson, narrowing below and slightly curved toward meson. Spermathecal ducts about as long as bulbs; first section very short; second section slightly shorter than third which is slightly expanded and bent at a right angle apically; bulb elongate elliptical, broadest submedially, slightly constricted postmedially, without differentiated distal section.

DISTRIBUTION.—*Anthrax cephus* occurs in tropical forests from southeastern Brazil through the Amazon Basin (Map 17).

TYPE.—According to notes supplied by R. H. and E. M. Painter, the type male of *Anthrax cephus* is in the Copenhagen Museum. Tips of the wings are broken off, the antennae are missing, and the body is greasy. It carries the label "*A. cephus* ex Am. Mer. Schmidt." The description of the type agrees with typical specimens of *A. cephus*. Fabricius gave "America Meridionali" as the type-locality.

DISCUSSION.—Two specimens from Chauguinois District, Panama, and La Suiza, Costa Rica, differ from specimens from Brazil in having a vertically defined hyaline area at the apex of the wing. Since specimens from northern and western Brazil tend to have the tip of the wing hyaline or subhyaline, it seems probable that the Central American specimens rep-

MAP 17.—Distribution of *Anthrax cephus*.

resent only an extreme manifestation of this characteristic and that they are the same species. Since the tops of the wings of the type are broken off, it is not possible to ascertain whether it showed this condition.

A specimen from Porto Cabral, Rio Paraná, São Paulo, Brazil, differs from other specimens in the same series in having the tip of the wing hyaline and areas in the preapical and posterior cells subhyaline. It seems probable that this specimen is a hybrid between *cephus* and *midas,* since a specimen of the latter was collected at the same locality.

For characters separating *cephus* from *aterrimus* see the latter species. *Anthrax cephus* differs from other species in the *cephus* complex in having the wing entirely pigmented or with only a small area apically hyaline, rather than with the apicoposterior half hyaline.

Anthrax aterrimus (Bigot)

Argyramoeba aterrima Bigot, 1892, p. 349 [*Argyromoeba*].
Anthrax aterrimus.—Painter and Painter, 1962, p. 72.—Krombein, 1967, p. 400.
Argyramoeba cephus.—Osten Sacken, 1877, p. 243.—Coquillett, 1894, p. 95.—Johnson, 1895, p. 325 [part] [not Fabricius, 1805; misidentification].
Spongostylum cephus.—Aldrich, 1905, p. 222 [*Spogostylum*] [not Fabricius, 1805; misidentification].
Spongostylum slossonae Johnson, 1913, 55.—Cole, Malloch, and McAtee, 1924, p. 186 [*Spogostylum*].
Anthrax slossonae.—Brimley, 1938, p. 341.

MALE.—Integument entirely black or legs and genitalia reddish brown; integument generally grayish and brownish pruinose, margins of eyes and lower part of occiput silvery pruinose. Setae and scales on front black; face with black setae extending up to antennae, few white setae along oral margin. Setae on occiput black, scales black above, white below; fringe of pile on posterior margin black exteriorly and white interiorly above, white below. First antennal segment slightly longer than apical width; second segment globular; base of third segment flattened mesolaterally, tapering gradually to styliform part which is about equal to base in length; style one-half to three-fourths as long as styliform part of third segment (Figure 96).

Setae and scales on mesonotum and scutellum mostly black; a few white or brown, threadlike scales in front of bases of wings and apically on scutellum. Sternopleuron, mesopleuron, and anterior half of pteropleuron with fine black setae and threadlike white scales; some white pile and some brown and/or black scales, setae, and hairs dorsally on mesopleuron and pteropleuron. Pile on prosternum, propleuron, and anterior margin of mesonotum white or with some brown and black hairs intermixed; postalar tuft of pile black with some hairlike white scales basally. A few white hairs behind spiracle; a few black setae and hairlike white scales anteroventrally on hypopleuron. Fore coxa with white scales and hairs and black setae; middle and hind coxae with mixed black and white scales and black setae.

Wing (Plate 4*d*) entirely pigmented with brown or black, discs of apical cells sometimes subhyaline, apical part of wing rarely entirely subhyaline. Stigmatic area lightly pigmented, calypter lightly pigmented, fringe of hairs brown. R–m crossvein located one-third to two-fifths of way from base to bifurcation of vein M_{1+2}; contact of cells $1M_2$ and Cu_1 slightly shorter to slightly longer than base of cell Cu_1. Vein R_4 with long spur at its basal angle.

Scales on legs entirely black; scales on hind tibia often semirecumbent. Middle femur with complete row of macrochaetae anteroventrally and one to several postmedial bristles on anterior side; posterior femur with complete rows of macrochaetae anteroventrally, posteroventrally, and anterodorsally. Posterior tibia with double row of macrochaetae anterodorsally.

Pile on lateral margins of first abdominal tergum white; terga two through four with dense black pile laterally, a few white hairs posteriorly on fourth tergum. Posterior margin of first tergum, discs of terga two through four, and medial part of five and sometimes six with sparse black setae and linear black scales. Remainder of posterior terga with dense, overlapping, posteriorly produced, silvery-white scales. Hairs and scales on venter sparse, black, white, or mixed, the white usually predominating anteriorly, the black posteriorly.

MALE GENITALIA (Figure 56).—Gonocoxites long, apical part narrow, dorsal margins tapering to ventral margins apically; apices rounded and slightly curved mesally in ventral view, folded inward mesally to form deep mesal sulcus; long setae covering entire surface almost to base. Basal segment of gonostylus oblong in lateral view, extending to base of distal segment, with dense tuft of setae apically; distal segment small, ovoid in ventral view, with short, truncate process extending outward near the apex and twisted apically, entire segment except styliform part with fine short setae. Apex of epiphallus flattened dorsoventrally, apex bluntly angled in dorsal view; a short, sharp recurved

lobe present on each side midway between junction of dorsal bands and apex; dorsal bands proximate mesally, with some setae before junction. Base of aedeagus small and narrow, almost tubular, tapering slightly to junction with ventral bands below lateral lobes of epiphallus.

FEMALE.—Similar to male. Pile and scales on thoracic pleura usually more predominantly white. Fore and middle femora and tibiae usually with white scales posteriorly; hind femur sometimes with a few white scales posteriorly at base. White scales and hairs on abdominal venter usually restricted to first three sterna. Silvery-white scales apically on abdominal terga restricted to posterolateral margins of five and six.

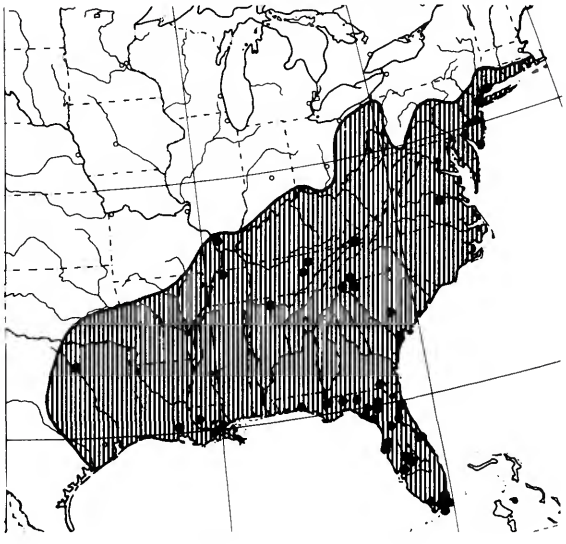
FEMALE GENITALIA (Figure 75).—Tenth tergum with about 27 spines on each side. Ventral arm of ninth tergum enlarged apically, irregularly margined. Dorsomedial corner of sclerite on each side of gonopore greatly produced dorsally as a rounded lobe; lateral arm short, broad and emarginate apically, extending posterolaterally; ventral arm broad evenly margined and twisted mesally on lower half. Each duct of spermathecae greatly elongated, about 6 times longer than bulb; first section very short; second section about two-thirds as long as apical section which is about 3.5 times longer than bulb and gradually expanded from base to apex; bulb slightly longer than wide, rounded, not well defined from duct.

DISTRIBUTION.—*Anthrax aterrimus* occurs in forested areas in southeastern United States as far north as Connecticut and the southern tip of Illinois, and as far west as central Texas (Map 18).

TYPES.—According to Painter and Painter (1962) the type of *Argyramoeba aterrima,* a female rather than a male as stated by Bigot, is in the Bigot collection of the British Museum. It is heavily draped with fungus but otherwise in good condition. It carries the label "*Argyromoeba aterrima* ♂ n. sp. Inédit. Quincy Juin 1886 J. Bigot Baltimore." Bigot's description agrees well with typical specimens of the species, including the paratype series of *slossonae* (Johnson).

The types of *Spongostylum slossonae* are in the Museum of Comparative Zoology at Harvard University. The entire series from which the species was described, with the exception of the types, has been examined by the author. The type-locality is Cumberland Gap, Kentucky.

BIOLOGY.—*Anthrax aterrimus* was recorded (as *cephus* Fabricius) as being "bred from the nest of a Mud-wasp in Texas, forming tubes of clay five or six



MAP 18.—Distribution of *Anthrax aterrimus.*

inches long, pasted together like organ-pipes," very probably *Trypoxylon politum* Say (Hymenoptera: Sphecidae), by Osten Sacken (1877). An additional specimen in the collection of R. H. Painter carries the label "bred from mud dauber nest." Krombein (1967) reared this species from nests of *Trypargilum striatum* (Provancher), *T. collinum rubrocinctum* (Packard), *T. clavatum, Isodontia auripes* (Fernald) (Hymenoptera: Sphecidae), *Euodynerus megaera* (Lepeletier), *Monobia quadridens* (Linnaeus), and *Ancistrocerus spinolae* (Saussure) (Hymenoptera: Vespidae).

DISCUSSION.—*Anthrax aterrimus* often has been confused with *cephus,* a South American species to which it is closely related. Specimens of *cephus* usually are darker, without subhyaline areas in the posterior cells of the wing, and with numerous black hairs and scales on the mesopleuron and sternopleuron. There is much variation, however, especially among specimens of *cephus,* so that the only certain diagnostic character is the male genitalia. In *aterrimus* the distal segment of the gonostylus is ovoid in ventral view with a short, twisted process extending outward near the apex (Figure 56). In *cephus* this structure is slightly larger, bulbous basally in ventral view, with a longer styliform process with a diagonally truncate tip (Figure 59). *Anthrax aterrimus* may be separated readily from other members of the *cephus* complex by the presence of pigment in the outer part of wing.

Anthrax aterrimus has also been confused with

analis, f. *grossbecki*. It may be distinguished readily by the presence of a small patch of hairs at the anterior corner of the hypopleuron and by the presence of a postmedial bristle on the anterior side of the middle femur.

Anthrax pluricellus Williston

Anthrax pluricellus Williston, 1901, p. 277 [*pluricella*].—Kertész, 1909, p. 51 [*pluricella*].—Painter and Painter, 1962, p. 79.

Exoprosopa capucina.—Rau, 1940, p. 594 [not Fabricius, 1805, misidentification].

MALE.—Body mostly black, tibiae and femora yellow; integument blue gray and brown pruinose; eye margins, face, and lower half of occiput white pruinose. Front with black setae and linear black and yellow scales; fringe of hairs on posterior margin black exteriorly, white interiorly above, white below. First antennal segment about as long as apical width; second segment globoid, slightly flattened apically; base of third segment flattened mesolaterally, narrower than second segment in lateral view, tapering abruptly to styliform part which is slightly longer than base and about 1.5 times as long as style (Figure 105).

Discs of mesonotum and scutellum with linear black scales; rust-brown scales broadly over anterior and lateral margins and in triangular patch posteriorly on mesonotum, and anteriorly and laterally on scutellum. Sternopleuron, lower half of mesopleuron, and anterior half of pteropleuron with black and gold setae, white and yellow scales, and sometimes a few black scales. Prosternum, propleuron, dorsal half of mesopleuron, and anterior margin of mesonotum with white pile, some black setae and hairs on last two areas. Postalar tuft of pile black, some white or yellow scales often present basally. Fore coxa with white bristles and gold scales. Hypopleuron bare; metapleuron with a few hairlike white scales behind spiracle.

Wing (Plate 4*a*) light brown with hyaline areas at apex and extending inward from posterior margin, pigment filling cells C, Sc, and R_1, extending beyond base of cell R_4 in cells R_{2+3} and R_5, filling base of cell R_4, and extending from cell R_5, broadly across base of cell M_1 and apex of cell $1M_2$ onto spurious vein in cell $2M_2$; extreme base of cell $2M_2$ and basal fourth of cell Cu_1 pigmented; extreme apex of cell M and apical spot in cell 2A hyaline. Vein R_4 angled basally, with a short spur; r–m crossvein at basal two-fifths of cell $1M_2$, vein R_{2+3} arising slightly basad; contact of cells $1M_2$ and Cu_1 slightly shorter than width of base of cell Cu_1; cell 1A punctiform apically; cell 2A not reduced, wider than cell 1A postmedially; alula reduced, posterior margin straight; a spurious vein extending from apical angle of m crossvein to posterior margin. Stigmatic area lightly pigmented. Calypter lightly pigmented, fringe of hairs white. Halter light brown, apical margin of knob yellow, base dark brown.

Bases of legs mostly with light-yellow scales, some black scales dorsally on femora at apex and dorsally on hind tibia. Middle femur with two or three macrochaetae anteroventrally toward apex; anterodorsal side of fore femur with a few weak macrochaetae; hind tibia with single row of macrochaetae anterodorsally.

Sides of first abdominal tergum with white pile, a large or small area of light or dark brown pile anteriorly; lateral margins of terga two through four with black pile, setae, and scales, numerous light brown hairs mixed with scales anteriorly on second tergum and posteriorly on terga two through four. Posterior margin of first tergum with sparse black or rusty-brown linear scales; discs of terga two through four and central half of five with linear black scales; rusty-brown scales present anteriorly on two and posteriorly on two through five; centers of terga six and seven with black scales anteriorly and rust-brown scales posteriorly. Sides of terga five through seven with patches of elongate, posteriorly produced, overlapping, lanceolate-truncate, white scales and with tufts of black and yellow setae and pile. Venter with fine white and yellow setae, and linear white and yellow scales, darkest posteriorly.

MALE GENITALIA (Figure 60).—Gonocoxites broad, dorsal margins broadly rounded to truncate apically in lateral view, apices broadly rounded in ventral view, medial sulcus not defined, setae sparsely distributed ventrally and along dorsal margin. Basal segment of gonostylus convex above in lateral view, with a few fine setae apically. Distal segment of gonostylus oval basally, somewhat flattened dorsoventrally with a broad mesal lobe in ventral view; styliform part curved outward, apex flattened apically; fine setae present dorsally and laterally at base. Apex of epiphallus broad, somewhat flattened dorsoventrally; dorsal part with a raised, basally projecting central lobe and truncate apex; lateral part with long, flat lobes projecting basolaterally. Dorsal bands meeting mesally, but not coalesced, with numerous short setae. Base of aedeagus large and bulbous, dorsal margin curving downward to junction with ventral bands below approximation of dorsal bands.

FEMALE.—Similar to male. White scales on posterior abdominal terga restricted to lateral margins of fifth segment.

FEMALE GENITALIA (Figure 83).—Tenth tergum with about 16 spines on each side. Ventral arm of ninth tergum slightly enlarged and undulate distally. Dorsomedial corner of sclerite on each side of gonopore produced dorsally as a dactylate lobe; lateral arm slightly broader than dorsal lobe and rounded apically; ventral arm narrow, tapering to apex which is evenly curved mesad. Each duct of spermathecae about as long as bulb; first segment very short; second segment about as long as third which is bent at about a right angle before expanding apically to bulb; bulb about 2.5 times longer than maximum width, tapering to junction with duct and with dark, slightly enlarged apical section.

DISTRIBUTION.—The specimens referred to by Rau (1940) as *Exoprosopa capucina* (Fabricius) have been studied by the author and are almost certainly *A. pluricellus,* since they agree closely with the description of the type given by Painter and Painter. These specimens were collected 40 km south of Ciudad Victoria, Tamulipas, Mexico. The type-locality is "Atoyac in Vera Cruz," Mexico. The species probably occurs all along the eastern coast of Mexico east of the Sierra Madre Oriental and perhaps inland on the central plateau.

TYPE.—Painter and Painter (1962) state that the type of *Anthrax pluricellus,* a female rather than a male as Williston indicated, is in the British Museum. It is in good condition except that the hind legs, one middle leg, and the left antenna are missing. Williston (1901) placed this species in *Anthrax* (auctt.) (*Villa* Lioy) since he believed that the head, which had been glued on, did not belong to the body.

BIOLOGY.—The specimens referred to by Rau were reared from the nests of *Chalybion zimmermanni* Dahlbom (Hymenoptera: Sphecidae).

DISCUSSION.—*Anthrax pluricellus, snowi,* and *costaricensis* differ from other species in having cell $2M_2$ divided by a spurious vein extending from the m crossvein to the wing margin. Only a single series of each species has been collected (with the exception of the type of *pluricellus*) and each appears to be distinct, although subsequent collecting may show that the taxa are only subspecies or variants of a polymorphic species. Because the taxa differ in several unrelated characters, and there is no significant variation within the series available, they are regarded here as distinct species.

Anthrax pluricellus differs from both *costaricensis* and *snowi* in having yellow rather than black femora and in having rusty-brown scales on the mesonotum, scutellum, and abdominal terga.

Anthrax snowi, new species

MALE.—Body mostly black, legs reddish black, integument blue green and brown pruinose; eye margins, face, and lower part of occiput white pruinose. Front with black setae and sparse black scales, a few white scales laterally below; face with mixed black and white setae extending almost to antennae. Occiput with black setae and a few black scales; fringe of hairs on posterior margin black exteriorly, white interiorly. First antennal segment about as long as apical width; second segment globoid, flattened apically; base of third segment flattened mesolaterally, about as wide as second segment in lateral view, tapering sharply to styliform part which is slightly longer than base and about 1.5 times longer than style (Figure 104).

Discs of mesonotum and scutellum with linear black scales, some white scales laterally in front of base of wings and along posterior margin of scutellum. Sternopleuron with white setae and hairlike scales, lower part of mesopleuron and anterior part of pteropleuron with black setae and hairlike white scales. Prosternum, propleuron, dorsal part of mesopleuron, and anterior margin of mesonotum with white pile; some black hairs and numerous black setae on last two. Fore coxa with white bristles and white scales, some black bristles apically; middle and hind coxae with black bristles and black and white scales. Hypopleuron and metapleuron bare.

Wing (Plate 4*a*) light brown with hyaline areas at apex and extending inward from posterior margin; pigment filling cells C, Sc, and R_1, extending beyond base of cell R_4, in cells R_{2+3} and R_5, filling base of cell R_4, extending from cell R_5 broadly across base of cell M_1 and apex of cell $1M_2$ onto spurious vein in cell $2M_2$, but not quite reaching posterior margin; base of cell $1M_2$ out to base of cell $2M_2$ and extreme anterior margin pigmented; extreme base of cell $2M_2$ and basal fourth of cell Cu_1 pigmented; extreme apex of cell M and large apical spot in cell 2A hyaline. Vein R_4 angled basally, with a short spur; r–m crossvein at basal two-fifths of cell $1M_2$, vein R_{2+3} arising slightly basad; contact of cells $1M_2$ and Cu_1 slightly shorter

than width of base of cell Cu_1; cell 1A punctiform apically; cell 2A not reduced, wider than cell 1A postmedially; alula reduced, posterior margin straight; a spurious vein extending from apical angle of m crossvein to posterior margin of wing. Stigmatic area lightly pigmented. Calypter lightly pigmented, fringe of hairs white. Halter light brown, apical margin of knob yellow, base dark brown.

Scales on fore and middle femora black anteriorly and mixed yellow and white posteriorly; hind femur with mixed yellow and white scales on basal half posteriorly; hind femur with mixed yellow and white scales on basal half posteriorly and extreme base anteriorly, remainder with black scales. Fore and middle tibiae with black scales anteriorly and white scales posteriorly; hind tibia with black scales. Middle femur with two or three macrochaetae anteroventrally toward apex; anteroventral row of macrochaetae on hind femur incomplete basally; anterodorsal surface of fore tibia with a few weak macrochaetae apically; hind tibia with a single row of macrochaetae anterodorsally.

Sides of first abdominal tergum with white pile, a large area of light-brown pile anteriorly; lateral margins of terga two through four with black pile, setae, and scales. Posterior margin of first tergum with sparse, black linear scales; discs of terga two through four and central half of five with linear black scales; lateral fourth of fifth tergum, and sixth and seventh with elongate, posteriorly produced, overlapping, lanceolate-truncate, white scales. Venter with fine white and yellow setae, and linear white and yellow scales, darkest posteriorly.

Male genitalia (Figure 61).—Gonocoxites broad, dorsal margins tapering convexly to blunt ventral angles in lateral view; apices broadly rounded in ventral view, inner margins rounded to broad, shallow mesal sulcus; setae evenly distributed, extending almost to base mesally. Basal segment of gonostylus sinuate dorsally in lateral view, acutely angled posteriorly, with short, rounded lobes covered with fine setae apically in ventral view. Distal segment of gonostylus broad basally with a short mesal projection, tapering to laterally curved styliform part; apex with oval flattened area; basal part with fine setae. Apex of epiphallus flattened dorsoventrally, projecting upward at a low angle; medial part broadly rounded apically in dorsal view, with a short, rounded projection basally, with shallow longitudinal sulci between medial and lateral parts; lateral parts rounded apically and curved downward, extending basally to middle of medial part. Dorsal bands narrow, united mesally, without setae. Base of aedeagus broad, bulbous, tapering dorsally to junction with ventral bands below junction of dorsal bands; ventral bands narrow, at a right angle preapically.

Variation.—The paratype male, the only other specimen available, is similar to the holotype.

Distribution.—This species is known only from the type-locality.

Holotype.—♂, Oak Creek Canyon, Cococino Co., Arizona, August, 6000 feet (F. H. Snow) (KANS).

Paratype.—♂, Oak Creek Canyon, Cococino Co., Arizona,—July, 6000 feet (F. H. Snow) (RHP).

Discussion.—*Anthrax snowi* may be distinguished from *pluricellus* by the reddish brown rather than yellow femora and the absence of rust-brown scales on the dorsal surface of the thorax and abdomen. It may be distinguished from *costaricensis* by the entirely pigmented apex of cell R_1 and the hyaline apices of cells 1A and 2A as well as by the lighter pigmentation of the wings.

Anthrax costaricensis, new species

Female.—Body black, legs dark red; integument mostly gray and brown pruinose. Front with black setae and linear scales; face with mixed black and yellow setae. Occiput with black setae above and white setae below; fringe of hairs on posterior margin black exteriorly and white interiorly above, white below. First antennal segment about as long as apical width; second segment globoid, apical margin flattened; base of third segment flattened mesolaterally, slightly wider than second segment in lateral view, tapering abruptly to styliform part which is slightly longer than base and about 1.5 times longer than style (Figure 106).

Discs and margins of mesonotum and scutellum with linear black scales. Sternopleuron, lower half of mesopleuron, and anterior half of pteropleuron with fine black setae and linear white scales, some white setae on sternopleuron. Prosternum with white pile; propleuron and anterior margin of mesonotum with white and brown pile, numerous black setae on latter; upper half of mesopleuron with white pile and black setae. Postalar tuft of pile black. Fore coxa with white bristles and scales, some black bristles apically; middle and hind coxae with black bristles, and black and white scales. Hypopleuron bare, metapleuron with a few white scales behind spiracle.

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Wing (Plate 4*b*) dark brown basally and anteriorly, and in a preapical band extending toward posterior margin; cells C and Sc filled, cell R_1 filled beyond apex of vein Sc and along anterior margin to apex; cells R_{2+3} and R_5 filled beyond base of cell R_4, cell R_4 filled; pigment extending from cell R_5 broadly across apex of cell $1M_2$ and base of cell M_1 almost to posterior margin on vein M_2 and spurious vein on m crossvein; base of cell $1M_2$ out to base of cell $2M_2$ and along extreme anterior margin, extreme base of cell $2M_2$ and basal fourth of cell Cu_1 pigmented; cells 1A and 2A completely pigmented. Base of cell R_4 angled, with short spur; r–m crossvein at basal two-fifths of cell $1M_2$ vein R_{2+3} arising opposite; contact of cells $1M_2$ and Cu_1 slightly longer than width of base of cell Cu_1; cell 1A punctiform apically; cell 2A not reduced, wider than cell 1A postmedially; alula reduced, posterior margin concave; a spurious vein extending from apical angle of m crossvein to margin of wing. Stigmatic area lightly pigmented. Calypter lightly pigmented, fringe of hairs white. Stem of halter light brown; knob dark brown basally, yellow at extreme apex.

Femora and hind tibia with black scales; a few white scales posteriorly on fore and middle femora; fore and middle tibiae with black scales anteriorly and white scales posteriorly. Middle femur with three or four small macrochaetae anteroventrally toward apex; anteroventral row of macrochaetae on hind femur incomplete basally; fore tibia with one or two macrochaetae anterodorsally; anterodorsal row of macrochaetae on hind tibia with double row of macrochaetae.

Lateral margins of first abdominal tergum with a large patch of black pile anteriorly surrounded by white pile; terga two through four with black pile and setae laterally. Posterior margin of first tergum with a few black scales; discs of terga two through seven with linear black scales, patch of lanceolate-truncate white scales laterally on five. Sterna one and two with fine white setae and linear white scales, a few black setae laterally on two; remaining sterna with black setae and scales.

FEMALE GENITALIA (Figure 82).—Tenth tergum with about 15 spines on each side. Ventral arm of ninth tergum undulating, expanded parallel to meson apically. Dorsomedial angle of sclerite on each side of gonopore elongated dorsomedially as a narrow, sharply rounded lobe; lateral arm short, narrow in dorsointerior view, curled under below; ventral arm narrow, parallel sided, almost straight. Each spermathecal duct about two-thirds as long as bulb; basal section very short; middle section about as long as distal section which is curved and expands distally to bulb; bulb elongate tubular, about four times longer than wide, with a lighter, slightly broader apical section about one-third of entire length.

VARIATION.—The two female paratypes do not vary appreciably from the type. The anterodorsal row of macrochaetae on the hind tibia is single in the paratypes.

DISTRIBUTION.—*Anthrax costaricensis* is known only from the type-locality, although it probably also occurs throughout much of Central America.

HOLOTYPE.—♀, La Suiza, Costa Rica, III–3 (F. Schild) (A. L. Melander collection) (USNM).

PARATYPES.—Costa Rica: 2♀, La Suiza, VII–18, 19 (F. Schild) (A. L. Melander coll.) (USNM, NLM).

DISCUSSION.—*Anthrax costaricensis* differs from *pluricellus* in having the femora black rather than yellow and in lacking rust-brown scales on the dorsal surface of the body. It differs from both *pluricellus* and *snowi* in having the wings pigmented with dark rather than light brown, in having the posterior edge of cell R_1 hyaline and in having cells 1A and 2A entirely pigmented rather than with subapical or apical hyaline areas.

Anthrax laticellus, new species

MALE.—Body black, femora and tibiae red; integument blue gray and brown pruinose. Front with black setae and linear white scales; face with black setae extending almost to antennae. Occiput with black setae and scales on upper three-fifths, with some white scales below; fringe of hairs on posterior margin black exteriorly, white interiorly on upper two-thirds, white below. First antennal segment shorter than apical width; second segment lenticular; base of third segment flattened mesolaterally, about as wide as second segment in lateral view, narrowing abruptly to styliform part which is slightly longer than base and about 1.5 times longer than style (Figure 120).

Discs and lateral margins of mesonotum and scutellum with linear black scales, a few white scales in front of base of wing. Sternopleuron, lower half of mesopleuron, and anterior half of pteropleuron with white setae, and few black setae present, especially on pteropleuron. Prosternum, propleuron, upper half of mesopleuron, and anterior margin of mesonotum with white pile, some white setae on mesopleuron and numerous

black setae on anterior margin of mesonotum. Postalar tuft of pile black. Coxae with black setae and black scales, some white scales on anterior pair. Hypopleuron and metapleuron bare.

Wing (Plate 5*f*) light brown basally and anteriorly, hyaline posteriorly. Pigment filling cells C and Sc, cell R_1 to base of cell R_4, and extending along anterior margin almost to apex, a short band extending across cell R_{2+3} to base of cell R_4; cell R_{2+3} filled two-thirds of way to base of cell R_4, a broad triangular band extending across cell R_5 halfway to base of cell R_4; extreme bases of cells R_5 and Cu_1 and anterobasal corner of cell $1M_2$ pigmented, a small spot present at base of cell $2M_2$; cell R entirely filled; margin of pigment extending from base of cell Cu_1 to posterior margin at extreme base of cell 2A. Cell R_4 angled at base, with a short basal spur; r–m crossvein at basal third of cell $1M_2$, vein R_{2+3} arising slightly apicad; contact of cells $1M_2$ and Cu_1 about 1.5 times longer than base of cell Cu_1; cell 1A punctiform apically. Cell 2A not reduced, wider than cell 1A postmedially; alula vestigial, posterior margin straight. Stigmatic area lightly pigmented. Calypter lightly pigmented, fringe of hairs brown. Halter light brown, knob dark brown.

Legs mostly with black scales, some white scales posteriorly on fore and middle femora and tibiae. Middle femur with one anteroventral bristle; row of macrochaetae on hind femur incomplete basally. Anterodorsal surface of fore tibia with a few weak macrochaetae anterodorsally; hind tibia with a single row of macrochaetae anterodorsally.

First abdominal tergum with white pile laterally; lateral margins of terga two through four with black pile and linear black scales. Posterior margin of first tergum with dense, linear, white scales. Discs of terga two through four and a medial spot on five with linear black scales; remainder of fifth tergum and sixth and seventh with dense, posteriorly produced, lanceolate, truncate, overlapping, white scales. Venter with white and yellow setae anteriorly and black setae posteriorly, a few white scales anteriorly and a few black scales posteriorly.

MALE GENITALIA (Figure 72).—Gonocoxites broad basally, tapering apically; apices with flat digitate areas ventrally defined by sharp lateral and mesal carinae. Basal segment of gonostylus rounded dorsally and acute apically in lateral view, extending little past the bases of the distal segments in ventral view. Distal segment of gonostylus triangular basally in ventral view, cylindrical and gradually tapering in lateral view, extending dorsolaterally with a preapical dorsolateral blunt tooth, and with the distal part angled sharply outward forming a sharp tooth and a flat apical surface; setae fine, on ventral and interior surfaces toward base. Dorsal part of apex of epiphallus with a medial sharp tooth extending upward and backward at a 60° angle, curving downward laterally, apex deeply emarginate in dorsal view; ventrolateral part bluntly rounded apically in lateral view. Dorsal bands narrow, not united mesally toward apex, without setae. Base of aedeagus broad but not bulbous, tapering gradually to junction with ventral bands beyond dorsal bands in lateral view.

VARIATION.—The only additional specimen of this species, a male, is similar in almost every respect to the holotype. The contact of cells $1M_2$ and Cu_1 is slightly shorter than the width of cell Cu_1.

DISTRIBUTION.—*Anthrax laticellus* is known only from the holotype and paratype. It may occur throughout the forested areas of northern and eastern Arizona.

HOLOTYPE.—♂, "Gr. Can." (Grand Canyon?), VII–11 (Adams collection) (RHP).

PARATYPE.—Arizona: *Cochise Co.*, ♂, Texas Pass, Dragoon Mts., VII–21–1917 (C.U. Expedit.) (NLM).

DISCUSSION.—The holotype is in rather poor condition. The left antenna is missing, and the front and face are covered with dirt. Part of the right wing is missing. The paratype lacks the apical segment of both antennae and five legs. Despite the poor condition of the types, this species is being described in order to make this revision as complete as possible.

Anthrax laticellus differs from other members of the *argyropygus* complex in having cell 2A of the wings as broad as cell 1A with its posterior margin strongly convex and having spots of darker pigment at the bases of cells R_4, R_{2+3}, R_5, and Cu_1.

Anthrax angustipennis Macquart

Anthrax angustipennis Macquart, 1840, p. 64.
Argyramoeba angustipennis.—Kertész, 1909, p. 60.
Anthrax binotatus Macquart, 1846, p. 113.

MALE.—Body black, femora and tibiae dark red; integument brown and gray pruinose. Front with black setae and a few black scales; setae on face black or mixed yellow and black. Occiput with black setae and a few black scales; fringe of hairs on posterior margin black exteriorly and white interiorly above, mostly white below. First antennal segment about as long as apical width; second segment globular; base of third

segment flattened laterally, tapering abruptly to styliform part, about as broad as second segment in lateral view; styliform part slightly longer than base, about twice as long as style (Figure 107).

Discs of mesonotum and scutellum with linear black scales, gold scales sometimes present laterally. Sternopleuron, lower half of mesopleuron, and anterior part of pteropleuron with fine black setae and linear yellow, black, or white scales. Pile on prosternum, propleuron, dorsal half of mesopleuron, and anterior margin of mesonotum white, some black hairs and setae on last two, or with predominantly black pile on last three. Postalar tuft of pile white. Fore coxa with black or white bristles and yellow, white, or black scales; middle and hind coxae with black bristles and black and/or yellow, or white scales. Hypopleuron and metapleuron bare.

Wing (Plate 5*d*) pigmented anteriorly and basally, hyaline posteriorly; pigment filling cells C, Sc, and R_1, filling cell R_{2+3} to base of cell R_4 and along apical margin to apex; margin of pigment extending posteriorly from base of cell R_4 to base of cell R_5; and thence to posterior margin at basal third of cell 2A. Base of cell R_4 angled, with short spur; r–m crossvein at basal two-fifths of cell $1M_2$, base of vein R_{2+3} slightly basad; contact of cells $1M_2$ and Cu_1 about 2.5 times longer than width of base of cell Cu_1; cell 1A punctiform apically; cell 2A somewhat narrowed, narrower than cell 1A postmedially; alula reduced, posterior margin straight. Stigmatic area heavily pigmented; calypter pigmented, fringe of hairs black. Stem of halter brown, knob brown basally, yellow apically.

Fore and middle femora with black scales anteriorly and a few white scales posteriorly; hind femur with black scales; fore and middle tibiae with black scales anteriorly and white scales posteriorly; hind tibia with black scales. Middle femur with three or four weak macrochaetae anteroventrally; fore tibia with complete row of macrochaetae anterodorsally, hind tibia with single row of macrochaetae anterodorsally.

Lateral margins of first abdominal tergum with yellow or white pile ventrally and black and brown pile dorsally; lateral margins of terga two through five with black setae, hairs, and scales. Posterior margin of first tergum with linear black scales; discs of terga two through four and sometimes center of five with linear black scales. Remainder of terga with dense, overlapping, posteriorly produced, lanceolate-truncate, white scales. Venter with yellow or black setae and white or black scales.

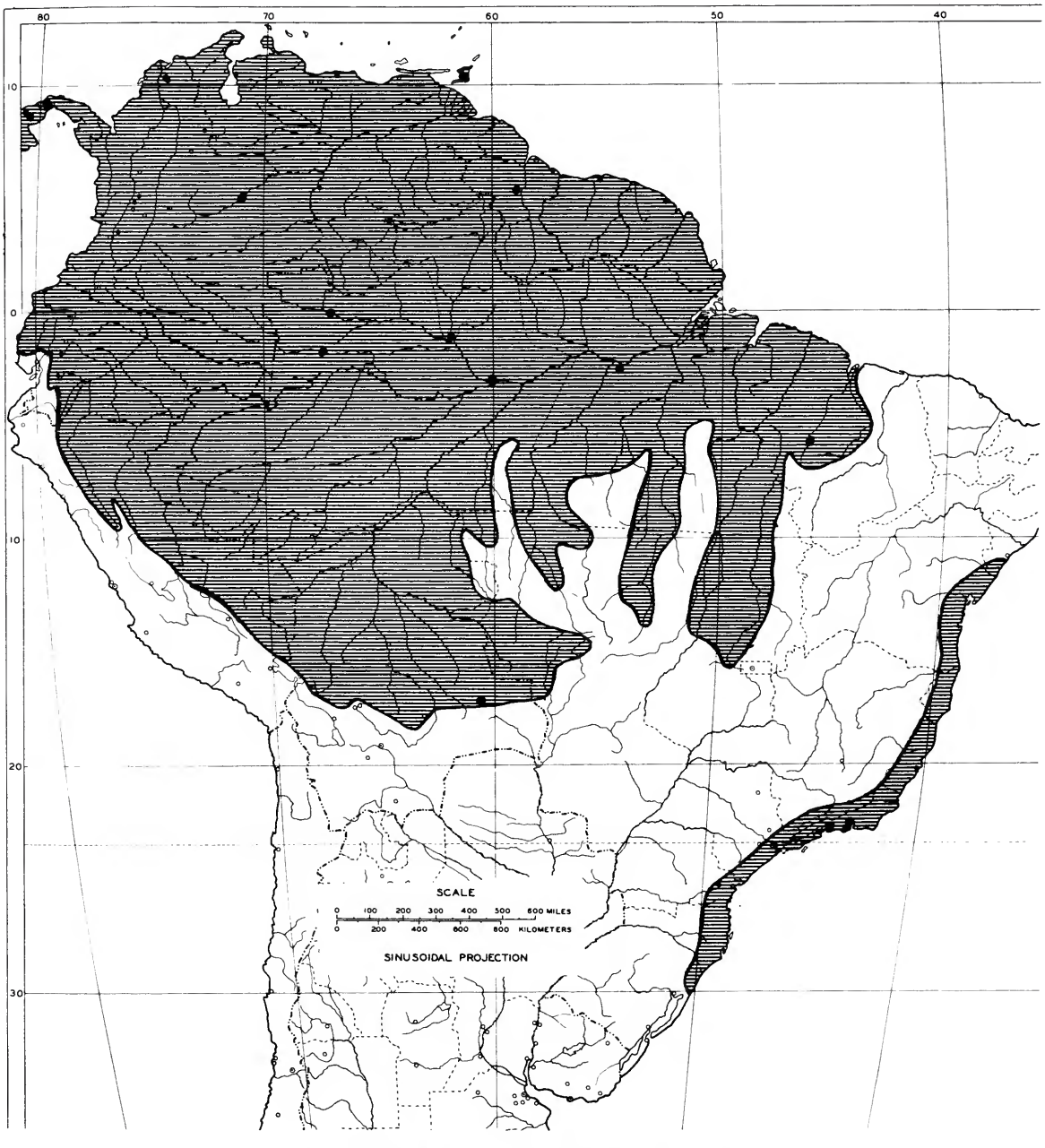
Male genitalia (Figure 69).—Gonocoxites long and narrow, slightly folded inward along mesal line apically; apices obtusely angled in ventral view; upper margins lined with setae, ventral parts with setae four-fifths of way to base. Basal segment of gonostylus normally developed, evenly rounded dorsally in lateral view, with a few fine setae mesally in ventral view; distal segment of gonostylus ovoid, with blunt tooth apically, with fine setae ventrally toward base. Dorsal part of apex of epiphallus bluntly rounded apically in dorsal view, evenly rounded laterally, with sharp projection basally; ventrolateral part evenly rounded outward, downward and inward from dorsal part and apex of basal bands, rounded basad apically. Dorsal bands with numerous setae both before and after their junction. Basal part of aedeagus long and slender, almost tubular, tapering slightly to junction with ventral bands beyond junction of dorsal bands.

Female.—Wing (Plate 5*e*) less extensively pigmented; pigmented area extending out to a line extending from tip of vein R_1 across cells R_1 and R_{2+3} to a point on vein R_{4+5} one-half to four-fifths of way to its bifurcation, diagonally across cell R_5 to a point on vein M_{1+2} one-fifth to one-half of way to its bifurcation, and then basally in a straight line to tip of vein 1A, or curving across apex of cell 1A to hind margin midway in cell 2A. Contact of cells $1M_2$ and Cu_1 only slightly longer than width of base of cell Cu_1.

Female genitalia (Figure 85).—Tenth tergum with about 21 spines on each side. Ventral arm of ninth tergum relatively broad, apex bilobed and turned inward distally. Dorsomedial corner of sclerite on each side of gonopore with very small dorsal angle; lateral arm very short, apically rounded; ventral arm long, broadened parallel to meson and tapering to sharp, mesally curved apex. Each duct of spermathecae about 3 times as long as bulb; first section very short, middle section about 1.5 times longer than third section which is slightly longer than bulb, expanded distally and with small expansions postbasally; bulb long and slender, symmetrical, about 3 times longer than wide and distinctly darker than duct.

Distribution.—The few specimens available of this species indicate that it occurs in the tropical rain forest of northern South America and in the Serra do Mar in eastern Brazil (Map 19).

Types.—The type male of *Anthrax angustipennis* is in the Paris Museum. According to notes supplied by R. H. and E. M. Painter, it carries the labels "No. 905 *Anthrax angustipennis*" and "Sources de l'oyapok 2896,



MAP 19.—Distribution of *Anthrax angustipennis*.

9?." It is badly rubbed, and the third antennal segments are missing. Specimens from the Amazon region of Brazil agree well with the redescription of the type given by Painter and Painter. The type-locality given in Macquart's description is "De la Guyane, aux sources de l'Oyapock." The river Oiapoque separates French Guiana from the Territorio do Amapá, Brazil.

According to notes supplied by R. H. and E. M. Painter, the two female types of *Anthrax binotatus* Macquart are in the Bigot collection of the British Museum under the label "*Anthrax binotatus,* n. sp." in Macquart's handwriting, pasted on a larger label with "Nova Grenada Nomm. par Macq." One of the specimens is headless but otherwise in good condition; the other has the third segments of the antennae missing, part of the head eaten, and a dense covering of fungus. Specimens from northern South America agree well with a redescription prepared by Painter. The type-locality is probably the island of Grenada in the British West Indies.

Discussion.—Females of *angustipennis* may be readily distinguished from females of related species by the absence of pigment in cell R_1 beyond the apex of vein R_1 and by the absence of a postbasal spot in cell R_5. Males may be distinguished by the ovoid, flattened distal segment of the gonostylus of the male genitalia and by the distinctive wing pattern. *Anthrax angustipennis* may distinguished from other species in South America by the greatly reduced, straight-margined alula.

An interesting male specimen from Jataí, Goiás, Brazil, appears to be a hybrid between *angustipennis* and *macquarti.* The wings are like those of *angustipennis* except that a patch of pigment extends into cell R_5 postbasally as in *macquarti.* The genitalia are nearer those of *macquarti,* the gonocoxites being short and broad, and the distal segment of the gonostylus styliform, although broadened in lateral view. The apex of the epiphallus has a dorsal plate as in *macquarti,* but the ventrolateral part projects laterally and posteriorly. The dorsal bands have setae as in *angustipennis.* This suggests that *macquarti* and *austrinus* are more closely related to *angustipennis* than to the *analis* complex.

Anthrax argyropygus argyropygus Wiedemann

Anthrax argyropygus Wiedemann, 1828, p. 313 [*argyropyga*].—Curran, 1927, p. 85 [*argyropyga*].—Brimley, 1938, p. 341 [*argyropyga*].—Painter and Painter, 1962, p. 71.—Krombein, 1967, p. 397.

Argyramoeba argyropyga.—Osten Sacken, 1877, p. 242.—Osten Sacken, 1878, p. 89.—Coquillett, 1894, p. 95.—Johnson, 1895, p. 325.—Kertész, 1909, p. 61.

Spongostylum argyropyga.—Aldrich, 1905, p. 222 [*Spogogostylum*].—Johnson, 1913, p. 54 [*Spogostylum*].—Cole, Malloch, and McAtee, 1924, p. 185 [*Spogostylum*].

Argyramoeba contigua Loew, 1869, p. 30; 1872, p. 144.

Male.—Body black, tibiae red; integument mostly gray and brown pruinose, eye margins silver pruinose. Front with black setae and linear scales; setae on face mixed black and white, extending almost to antennae. Setae and scales on occiput entirely black, or black above and white below; fringe of hairs on posterior margin black above and mixed black and white below, or black exteriorly and white interiorly above and white below. First antennal segment about 1.5 times longer than apical width; second segment lenticular; base of third segment flattened laterally, about as wide as second segment, narrowing abruptly to styliform part which is about equal in length to base and style (Figure 110).

Disc of mesonotum with linear black scales; margins with black scales, or often with linear gold scales in front of wing or along entire margin, in a posterior triangular area, and along anterior margin; white scales sometimes in front of wing when gold scales are absent. Disc of scutellum with linear black scales; posterior margin usually with gold scales, often with white scales medially and sometimes along entire margin; anterior margin often with gold scales. Sternopleuron, lower half of mesopleuron, and anterior half of pteropleuron with yellow, black, or mixed, fine setae, and yellow and white linear scales. Dorsal part of mesopleuron with black, or mixed gold and black, setae and white, or mixed white and yellow pile. Prosternum with white pile, some black hairs rarely intermixed, propleuron with white pile, or often with yellow hairs intermixed and rarely with some black hairs; anterior margin of mesonotum with white and black, or white, yellow and black pile. Anterior coxa with black and white, or black, yellow, and white bristles and yellow, white, or mixed, scales; middle and hind coxae with black, or black and gold bristles, and gold, yellow, black, white, or mixed, scales. Metapleuron sometimes with a few scales posteroventral to spiracle.

Wing (Plate 5*i*) pigmented brown anterobasally, hyaline posteriorly; pigment filling cells C and Sc, cell R_1 entirely pigmented except a crescent-shaped area along posterior margin preapically, and rarely a linear hyaline area submedially and basally; pigment usually extending from apex of cell R_1 across cell R_{2+3}; cell

R_{2+3} filled to base of cell R_4 except for a triangular area along posterior margin before base of cell R_4, entire posterior part of cell rarely hyaline, a triangular area of pigment usually extending from cell R_{2+3} into cell R_5 between bases of cells R_{2+3} and R_4; extreme base of cell R_4 often pigmented; cell R entirely pigmented, or often with subhyaline or hyaline area preapically; cell M entirely pigmented; cell $1M_2$ usually filled out to a line from r–m crossvein to near base of cell Cu_1, rarely only at extreme base; base of cell Cu_1 pigmented or rarely entirely hyaline; apical margin of pigment running from base of cell Cu_1 to posterior margin, leaving apical one-third to two-thirds of cell 2A hyaline. Base of cell R_4 angled, often with short spur; r–m crossvein at basal two-fifths of cell $1M_2$, base of cell R_{2+3} at or slightly before r–m crossvein. Contact of cells $1M_2$ and Cu_1 2.0 to 2.5 times as long as width of base of cell Cu_1; cell 1A narrowly to broadly open apically. Cell 2A narrower than cell 1A postmedially, posterior margin incurved; alula vestigial, posterior margin straight. Stigmatic area moderately pigmented. Calypter pigmented, fringe of hairs yellow and white. Halter dark brown or black, knob black or yellow at extreme apex.

Scales on fore and middle femora black anteriorly, white, yellow or mixed posteriorly, rarely entirely black, hind femur with yellow and white scales posterobasally, and black scales anteroapically, scales rarely entirely black. Scales on fore and middle tibiae black anteriorly, white posteriorly; scales on hind tibia black. Middle femur with five or six macrochaetae anteroventrally; hind femur with complete row of macrochaetae anteroventrally. Anterodorsal margin of fore tibia with weak macrochaetae on apical half; hind tibia with a single row of macrochaetae anterodorsally.

Sides of first abdominal tergum with white pile, usually with some yellow hairs and black setae, rarely predominantly brown and yellow; sides of terga two through four with black setae, hairs, and linear scales. Posterior margin of first tergum with long, gold or white scales, or with white scales laterally and gold scales medially. Discs of terga two through four and center of five with linear black scales; linear gold scales usually in lateral bands posteriorly on two through four and on anterolateral corners of two, sometimes extending entirely across segments; abdomen rarely without gold scales. Lateral thirds of fifth tergum, and six and seventh with dense, overlapping, posteriorly produced, lanceolate, truncate, white scales. Venter with sparse, fine setae, white anteriorly, yellow posteriorly and sometimes on first sternum; scales on sterna usually white; yellow or black scales sometimes present.

MALE GENITALIA (Figure 66).—Gonocoxites long, broad basally, tapering apically beyond middle; apices bluntly angled dorsally in lateral view and apically in ventral view. Basal segment of gonostylus rounded dorsally in lateral view, with two short setaceous, membranous lobes mesally in ventral view; apical segment of gonostylus short, extending outward and slightly apicad, triangular basally in ventral view, with a short styliform part, apex slightly bent dorsoapically. Apex of epiphallus with a convex, transverse shieldlike structure above, with sharp dorsolateral angles, without a medial angle, and shallowly emarginate apically below; ventrolateral area rounded below, diagonally truncate apicoventrally. Dorsal bands united apically, with numerous setae both before and after junction. Base of aedeagus narrow and tubular, tapering slightly to junction with ventral bands well before junction of dorsal bands.

FEMALE.—Similar to male. Thoracic pleura with mostly white scales and pile; coxae with white scales and mostly with white bristles. Pigment on wing (Plate 5*j*) more extensive, cell R_5 filled to base of cell R_4, a crescent-shaped hyaline area sometimes present postbasally; pigment sometimes extending along base of cell M_1; cell $1M_2$ pigmented out to base of cell $2M_2$; cells 1A and 2A entirely pigmented except for apices; contact of cells $1M_2$ and Cu_1 about 1.5 times as long as width of base of cell Cu_1. Light scales on legs usually mostly white rather than yellow. Gold scales on abdominal terga usually less extensive, sometimes absent; white scales on posterior terga restricted to lateral margins of fifth tergum. Venter usually with numerous linear black scales posteriorly, sometimes with black setae posteriorly.

FEMALE GENITALIA (Figure 86).—Tenth tergum with about 18 spines on each side. Ventral arm of ninth tergum parallel sided, not enlarged apically. Dorsomedial corner of sclerite on each side of gonopore not produced, with a sharp angle dorsally; lateral arm short and acute; ventral arm narrow and parallel sided. Each spermathecal duct about 3.5 times longer than bulb; first section very short; second section about 2.5 times longer than third, which is about as long as bulb and expanded apically; bulb cylindrical, about 3 times longer than wide, broadest subapically and not well defined from duct.

DISTRIBUTION.—*Anthrax argyropygus argyropygus* occurs in forested areas throughout eastern United States and along the east coast of Mexico (Map 20). The few specimens available from Mexico seem to indicate that it is allopatric to *argyropygus albosparsus*.

TYPES.—According to Painter and Painter (1962), the apparent type male of *Anthrax argyropygus* Wiedemann is in the Vienna Museum. The specimen is in good condition except that it lacks the third segment of the right antenna. It carries the labels "America" and "*argyropyga* Alte Sammlung" which are not in Wiedemann's handwriting. Wiedemann recorded the type-locality as "Vaterland?." The redescription of the specimen agrees well with typical males from southeastern United States.

The type female of *Argyramoeba contigua* Loew is presumably with the remainder of Loew's types in the Museum of Comparative Zoology at Harvard University. The type-locality is Virginia. The description agrees well with typical specimens from that area.

BIOLOGY.—One reared specimen has been seen in the collections examined by the author. It emerged from the nest of a "Trypoxylonid" (Hymenoptera: Sphecidae). Krombein (1967) reared this subspecies from *Trypargilum collinum collinum* (Smith), *T. c. rubrocinctum* (Packard), *T. striatum* (Provancher), *T. tridentatum archboldi* (Krombein) (Hymenoptera: Sphecidae), *Ancistrocerus catskill catskill* (Saussure), *Stenodynerus fulvipes fulvipes* (Saussure), *S. pulvinatus surrufus* Krombein, *S. saecularis rufulus* Bohart, *S. beameri* Bohart, and *Pachodynerus erynnis* (Lepeletier) (Hymenoptera: Vespidae).

MAP 20.—Distribution of *Anthrax argyropygus argyropygus* (vertical lines), *A. argyropygus albosparsus* (horizontal lines) and *A. argyropygus painteri* (diagonal lines).

DISCUSSION.—Specimens from southeastern United States are usually darker than those from other regions, having the gold scales on the thorax and abdomen less extensive or absent. Two variant specimens in poor condition from Tehuantepec, Oaxaca, Mexico, appear to belong to this subspecies. They have more extensive patches of gold scales on the thorax and abdomen than the other specimens available from Mexico. The genitalia of the male have the dorsolateral corners of the apex of the epiphallus acutely angled rather than bluntly angled as in specimens from the United States. The female has the pigment in cell R_5 of the wing extending broadly along the base of cell M_1. Another male labeled Tehuantepec has genitalia like those of *a. albosparsus* (Bigot).

The interrelationships of the subspecies of *argyropygus* are not well understood. *Anthrax a. painteri* seems to be isolated in the mountainous area of eastern and southern Arizona. *Anthrax a. argyropygus* and *a. albosparsus,* on the other hand, seem to be allopatric or perhaps even partially sympatric in southern Mexico. Specimens that appear related to each species have been seen from Tehuantepec, Oaxaca. Many more specimens from critical areas in southern Mexico will be required to determine the true relationships of the taxa.

Both *a. argyropygus* and *a. albosparsus* may be distinguished from *a. painteri* by the presence of pigment in cell M in the male and in the apical half of cell 1A in the female. Mexican specimens of *a. argyropygus* may be separated from *a. albosparsus* by the presence of linear gold scales on the mesonotum, scutellum, and anterior abdominal terga, and by the numerous black and gold hairs and setae on the pleura of the females.

Anthrax argyropygus painteri, new subspecies

MALE.—Body black, tibiae red; integument blue gray and brown pruinose, eye margins silver pruinose. Front with black setae and a few black and white scales; face with mixed black and white setae. Occiput with black setae on upper two-thirds, with white setae below; scales on occiput mostly white, a few black ones dorsally; fringe of pile on posterior margin black exteriorly and white interiorly on upper third, white on lower two-thirds. First antennal segment about 1.5 times longer than apical width; second segment lenticular; base of third segment flattened laterally, narrowing abruptly to styliform part, about as wide as second segment in lateral view; styliform part slightly longer than base, 1.0 to 1.5 times longer than style (Figure 112).

Disc of mesonotum with linear black scales; a few linear gold scales on lateral margin in front of base of wing, and on anterior half and posterior part of disc. Scutellum with linear black scales on disc and linear white scales on posterior margin, a few gold scales laterally. Sternopleuron, mesopleuron, and anterior half of pteropleuron with white setae and scales, a few coarse black and gold setae on mesopleuron and pteropleuron; upper half of mesopleuron with white pile. Prosternum, propleuron, and anterior margin of mesonotum with white pile; postalar tuft of pile black. Coxae with coarse white and black bristles, white scales, and a few yellow bristles. Hypopleuron and metapleuron bare.

Wing (Plate 5*g*) mostly hyaline, cells C and Sc pigmented light brown; bases of cells R_{2+3} and R_5 narrowly surrounded by pigment; vein R_{2+3} narrowly lined with pigment as far as base of cell R_4; a small spot present apically in cell R_1; spur at base of cell R_4 narrowly lined with pigment; small spots present at bases of cells Cu_1 and $1M_2$ and in cell R below base of R_1; base of wing filled out to base of cell M. Base of cell R_4 angled, with long spur; r-m crossvein at basal third of cell $1M_2$; base of vein R_{2+3} slightly basal to r-m crossvein; contact of cells $1M_2$ and Cu_1 about four times as long as width of base of cell Cu_1; cell 1A broadly open; cell 2A reduced, narrower than cell 1A; alula vestigial, posterior margin straight. Calypter lightly pigmented, fringe of hairs white. Halter brown, knob yellow posteriorly at tip.

Fore and middle femora with black scales anteriorly and some white and yellow scales posteriorly, posterior femur with yellow scales covering basal third posteriorly and extreme base anteriorly, remainder with black scales. Fore and middle tibiae with black scales anteriorly and white scales posteriorly, hind tibia with black scales. Middle femur with three macrochaetae anteroventrally; hind femur with a complete row of macrochaetae anteroventrally; fore tibia with a few weak macrochaetae anterodorsally.

Lateral margins of first abdominal tergum with white pile; lateral margins of terga two through four with black setae, hairs and linear scales, some gold scales and hairs anteriorly on second. Posterior margin of first tergum with long, lanceolate white scales; discs of terga two through four and middle of five with linear black scales, narrow bands of linear gold scales on anterior and posterior margins of two and posterior

margin of three. Lateral thirds of fifth tergum and sixth and seventh with dense, overlapping, posteriorly produced, lanceolate, truncate, white scales. Venter with yellow and white setae and white scales, some black setae and scales posteriorly.

MALE GENITALIA (Figure 68).—Gonocoxites short, broad basally, tapering, relatively broad apically; apices with sharp dorsal angles in lateral view, concave laterally and bluntly angled apically in ventral view. Basal segment of gonostylus sharply curved dorsally in lateral view, with narrow, membranous lobe medially in ventral view, lobe covered with fine setae; distal segment of gonostylus triangular basally, tapering outward to a short styliform apex which is slightly expanded and truncate. Setae on gonocoxites extending back as far as medial fold, densest apically below; base of distal segment of gonostylus with fine setae. Dorsal part of apex of epiphallus formed as a transverse convex shield with sharp lateral angles and a very small medial angle dorsally, with a deep, right-angled apical emargination below; ventrolateral part extending beyond dorsal part as narrow truncate lobe. Dorsal bands with numerous setae, united mesally, broadly curved to junction with apex of epiphallus. Base of aedeagus narrow and tubular, tapering gradually to junction with ventral bands well before junction of dorsal bands.

FEMALE.—Similar to male. Wing (Plate 5*h*) more extensively pigmented; cell R_1 filled except for a crescent-shaped hyaline area preapically along posterior margin, pigment extending apically into cell R_{2+3}; cell R_{2+3} filled to base of cell R_4 except for a small hyaline area before base of cell R_4 posteriorly; a triangular area extending from cell R_{2+3} into R_5 midway between bases of cells R_{2+3} and R_4; bases of cells R_5, $1M_2$, and Cu_1 pigmented; cells R and M completely filled, anterobasal part of cell 1A filled.

FEMALE GENITALIA (Figure 88).—Tenth tergum with about 16 spines on each side. Ventral arm of ninth tergum narrow basally, broadened apically to form a flat, mesally projecting flat plate. Dorsomedial angle of sclerite on each side of gonopore not projecting, obtusely rounded; lateral arm tapering to sharp, slightly upcurved apex; ventral arm parallel sided on basal two-thirds before tapering to sharp apex. Each duct of spermathecae about 3.5 times longer than bulb; basal section very short; middle section about 1.75 times longer than apical section which is slightly longer than bulb and expanded apically; bulb symmetrical, elongate elliptical, slightly wider postbasally.

VARIATION.—The additional specimens examined do not vary significantly from the holotype and allotype.

DISTRIBUTION.—The few specimens available of *painteri* were collected in mountainous areas in southeastern Arizona (Map 20). It may also occur in adjacent areas of similar habitat in central Arizona, western Texas and extreme north-central Mexico.

HOLOTYPE.—♂, Southwest Research Station, 5 mi. W Portal, Pima Co., Arizona, VIII–13–1959, 5400 feet (H. E. Evans) (RHP).

ALLOTYPE.—♀, Washington, Santa Cruz Co., Arizona, VIII–6–1932 (R. H. Painter) (RHP).

PARATYPES.—Arizona: *Cochise Co.*, ♂, Chiricahua Mts., VII–4–1940 (D. E. Hardy) (RHP); ♂, Southwest Research Station, 5 mi. W Portal, VIII–18–1959, 5400 feet (H. E. Evans) (NLM).

OTHER MATERIAL EXAMINED.—Arizona: *Cochise Co.*, ♀, Canelo (Hyatt's Ranch), VI–30–1958 (A. and H. Dietrich); ♂, 5 mi. W Portal, Chiricahua Mts., VIII–7–1958 (R. M. Bohart). *Pima Co.*, ♂, Baboquivari Canyon, W Side Baboquivari Mts., VII–25–27–1952 (H. B. Leech and J. W. Green); ♂, Santa Rita Mts., VI–22–1935 (F. H. Parker).

DISCUSSION.—The male of *a. painteri* differs from both *a. argyropygus* and *a. albosparsus* in having cell M hyaline except at the extreme base and apex rather than completely pigmented. The female may be distinguished by the lack of pigment in the apical half of cell 1A and cell 2A. *Anthrax a. painteri* differs from *laticellus* in having cell 2A very narrow with its posterior margin broadly concave.

Anthrax argyropygus albosparsus (Bigot)

Argyramoeba albosparsa Bigot, 1892, p. 348 [*Argyromoeba*].—Kertész, 1909, p. 60 [*albosparse*].

Spongostylum albosparsum.—Aldrich, 1905, p. 222 [*Spogostylum*].

Anthrax albosparsus.—Painter and Painter, 1962, p. 69.

Argyramoeba angustipennis.—Williston, 1901, p. 275 [not Macquart, 1840; misidentification].

Spongostylum angustipennis.—Aldrich, 1905, p. 222 [*Spogostylum*] [not Macquart, 1840; misidentification].

MALE.—Body black, tibiae red; integument mostly gray and brown pruinose, eye margins and lower half of occiput white pruinose, upper half of occiput blue green pruinose. Front with black setae and lanceolate black scales, a few white scales laterally below; face with black setae extending almost to antennae, a few white setae below; setae on occiput black, scales black, a few white ones below; fringe of hairs on posterior

margin black externally and white internally above, white below. First antennal segment about twice as long as apical width; second segment lenticular, about as wide as base of third segment which is flattened laterally and narrowed abruptly to styliform part; styliform part about equal in length to base and style (Figure 111).

Mesonotum and scutellum with linear black scales, some white scales on posterior margin of scutellum. Sternopleuron, lower half of mesopleuron, and anterior half of pteropleuron with black setae and hairlike white scales. Prosternum and propleuron with white pile; dorsal half of mesopleuron and anterior half of mesonotum with white pile and black setae; postalar tuft of pile black. Fore coxa with white and black bristles, and white scales; middle and hind coxae with black setae and a few white scales, a few white setae present. Hypopleuron and metapleuron bare.

Wing (Plate 3*h*) brown anteriorly and basally, hyaline posteriorly; cells C and Sc filled with pigment, cell R_1 pigmented out to apex, a crescent-shaped hyaline area preapically and elongate hyaline areas at base and submedially; cell R_{2+3} pigmented along upper margin as far as base of cell R_4; cell R pigmented except for a preapical hyaline spot; cell M entirely pigmented; extreme bases of cells $1M_2$ and Cu_1 pigmented; apical margin of pigment in cells 1A and 2A extending from base of cell Cu_1 to posterior margin just beyond base of cell 2A. Base of cell R_4 angled; r–m crossvein at basal two-fifths of cell 1 M_2, vein R_{2+3} arising slightly basad; contact of cells $1M_2$ and Cu_1 about 2.5 times longer than width of base of cell Cu_1; posterobasal part of wing greatly reduced; cell 1A broadly open; cell 2A narrowed, much narrower than cell 1A postmedially, posterior margin incurved; alula vestigial, posterior margin straight. Stigmatic area lightly pigmented. Calypter lightly pigmented, fringe of hairs white and yellow. Halter brown, knob brown above except at extreme apex, yellow below.

Scales on femora mostly black, a few yellow scales posteriorly on fore and middle pairs; fore and middle tibiae with black scales anteriorly and yellow and white scales posteriorly; posterior tibia with black scales. Middle femur with one or two macrochaetae anteroventrally; anteroventral row of macrochaetae on hind femur incomplete basally. Anterodorsal surface of fore tibia with a few weak macrochaetae; hind tibia with single row of macrochaetae anterodorsally.

Sides of first abdominal tergum with white pile; lateral margins of terga two through four with black setae, hairs, and linear scales. Posterior margin of first tergum with lanceolate white scales; discs of terga two through four and middle of five with linear black scales. Lateral thirds of fifth tergum, and sixth and seventh with dense, overlapping, posteriorly produced, lanceolate-truncate, white scales. Sterna with fine, sparse, white and black setae anteriorly and black setae posteriorly, with a few linear black scales.

Male genitalia (Figure 67).—Gonocoxites short and broad ventrally; apices with sharp dorsal lobes and slightly obtuse ventral angles; setae evenly distributed over anterior parts, extending almost to base ventrally. Basal segment of gonostylus rounded in lateral view, with a membranous lobe medially extending beyond base of apical segment and covered with fine setae; base of distal segment of gonostylus rounded transversely, flattened apically, tapering outward to a long narrow styliform part bent sharply upward and inward at apex. Dorsal part of apex of epiphallus formed as a transverse shieldlike structure, convex exteriorly with acute lateral angles; ventrolateral parts bluntly rounded apically, extending far beyond dorsal part, thus forming a deep medial emargination below. Dorsal bands joined mesally, very broad before junction, with a line of setae extending almost to apex. Base of aedeagus narrow, evenly rounded dorsally, undulated ventrally, narrowing to junction with ventral bands before junction of dorsal bands.

Female.—Setae on sternopleuron and lower half of mesopleuron all white. Yellow scales more extensive on posterior surfaces of fore and middle femora. Wing (Plate 3*i*) more extensively pigmented; cell R_1 without hyaline areas basally; cell R_{2+3} pigmented out to base of cell R_4 except for a concave hyaline area before base of cell R_4, cell R_5 with a large spot extending from cell R_{2+3} between bases of cells R_5 and R_4; bases of cells $1M_2$ and Cu_1 broadly pigmented; cell 1A pigmented except at extreme apex; contact of cells $1M_2$ and Cu_1 about twice as long as width of base of cell Cu_1. Posterior margin of first abdominal tergum with dense, long, lanceolate white scales; posterior margins of second and third terga with small spots of white scales medially; white scales on posterior segments restricted to lateral margins of fifth tergum. First two sterna with mixed black and white setae, posterior sterna with black setae and black scales.

Female genitalia (Figure 87).—Tenth tergum with about 18 spines on each side. Ventral arm of nine tergum undulating and expanding mesally into a broad, dorsally convex plate at apex. Dorsomedial

angle of sclerite on each side of gonopore rounded, not produced; lateral arm tapering to a sharp, upturned apex; ventral arm tapering and slightly curving mesad toward apex. Each spermathecal duct about twice as long as bulb; basal section very short; medial section about 2.5 times longer than apical section which is straight; bulb elongate, tapering from just before apex to base and sharply rounded apically.

DISTRIBUTION.—*Anthrax a. albosparsus* occurs in the forested areas of southern Mexico (Map 20). The few specimens available indicate that it may be allopatric to *a. argyropygus* on the east. The one specimen of this species collected by the author was found in a steep, rocky canyon 18 miles north of Chilpancingo, Guerrero. The vegetation was an open, subtropical evergreen forest with numerous cacti and other xerophytic plants.

NEW MATERIAL EXAMINED.—Guatemala: ♀, Quirigua, August (Schaus and Barnes).

Mexico: *Guerrero,* ♂, Acapulco, VI–15–1935 (A. E. Pritchard); ♀, 18 mi. N Chilpancingo, VIII–7–1962 (N. Marston–8). *Morelos,* ♀, 11 mi. E Cuernavaca, Lobo Canyon, VIII–15–1962, 3900 feet (R. H. and E. M. Painter); ♂, 12 mi. E Cuernavaca, Lobo Canyon, VIII–14–1962, 3600 feet (R. H. and E. M. Painter). *Oaxaca,* ♂, Tehuantepec (Sumichrast).

TYPE.—According to Painter and Painter (1962) the type of *Argyramoeba albosparsa* Bigot, a female, is in the Bigot collection in the British Museum. It carries the label "*Argyramoeba albosparsa* ♀, n. sp. Inédit. Quinz. 1888 J. Bigot. Am. du Nord Colorado." The redescription by Painter and Painter along with the photograph of the wing of the type indicates that this specimen is a typical member of the species *argyropygus* closely allied to the subspecies from eastern United States and Mexico.

DISCUSSION.—Because the subspecies of *argyropygus* have not been collected in Colorado, it seems unlikely that this specimen came from there. Also, the remainder of Bigot's species described from specimens collected in 1888 were from the Pacific coast. It is possible that the "Colorado" refers to the Colorado River, but this seems unlikely since the females of the Arizona subspecies have most of cells 1A and 2A hyaline whereas the type has these cells completely pigmented. Another possibility is that the type came from southern Mexico. If this is the case, the type-locality may be the small town of Tierra Colorado just north of Acapulco. This seems plausible since the person who collected Bigot's specimens apparently was traveling by ship and probably stopped at Acapulco either on his way to California or in returning. As the description of the type fits very well a specimen collected by the author 18 miles north of Chilpancingo, Guerrero, the name *albosparsus* is being used for this southern Mexico subspecies.

A female collected near Cuernavaca, Morelos, differs from the typical form in having the wing more heavily pigmented with the margin indistinct. Cell R_1 is entirely pigmented as far as the apex of vein Sc, and the pigment extends across cell R_{2+3} into the base of cell R_4; cells R_{2+3} and R_5 are pigmented as far as the base of cell M_1, and the pigment extends across the apex of cell $1M_2$ into the base of cell M_1 and the anteromedial angle of cell $2M_2$; cells $1M_2$ and Cu_1 are pigmented beyond the base of cell $2M_2$; cell 1A is entirely pigmented and cell 2A is subhyaline. The posterobasal part of the wing is less reduced than in the typical form, with cell 2A as wide as cell 1A postmedially. Whether or not this specimen belongs to *a. albosparsus* is a matter of conjecture. It is being placed here since it seems to be only an extreme manifestation of the normal variation noted in the species *argyropygus.*

A female from Quirigua, Guatemala, is tentatively placed with this species since it lacks the gold scales that seem to characterize Mexican specimens of *a. argyropygus.* It differs from the female described in having the wing more extensively pigmented, cells 1A and 2A being entirely filled; cell 2A is wider, almost as wide as cell 1A. The scales on the first abdominal tergum and the scales and setae on the sternopleuron and mesopleuron are black.

The limited material available of *a. albosparsus* indicates that the females of this species differ from females of *a. argyropygus* from Mexico in lacking gold scales posteriorly on abdominal terga two and three and in having the posterior margin of the first tergum lined with dense white scales. Males of *a. albosparsus* differ from those of *a. argyropygus* in lacking gold scales on the thorax and abdomen and in having the ventrolateral parts of the apex of the epiphallus projecting forward, thus creating a deep medial emargination in dorsal view.

Anthrax innubilipennis, new species

MALE.—Body black, mostly brown and gray pruinose, margins of eyes and lower part of occiput silver pruinose. Front with black setae and a few linear black

scales. Face with mixed black and white setae extending almost to antennae. Occiput with black setae and scales on upper half, with white setae and scales on lower half; fringe of hairs on posterior margin black externally and white internally on upper half, white on lower half. First antennal segment about twice as long as apical width; second segment globular; base of third segment flattened laterally, narrowing abruptly to styliform part, about as wide as second segment; styliform part of third segment about as long as base, about 1.5 times longer than style (Figure 109).

Disc of mesonotum mostly with linear black scales; lateral and anterior margins and triangular area on posterior margin with linear gold scales. Disc of scutellum with linear black scales; anterior and posterior margins with linear gold scales. Sternopleuron with fine yellow setae and linear yellow scales; mesopleuron and anterior half of pteropleuron with yellow and gold setae and hairs, some coarse black and gold setae above, and some white pile anteriorly on mesopleuron. Pile on prosternum, propleuron, and anterior margin of mesonotum white, some gold hairs on propleuron. Postalar tuft of pile mixed gold and black. Metapleuron with linear scales posteroventral to spiracle; hypopleuron with some hairs and scales on anteroventral corner. Fore coxa with gold setae and lanceolate white scales; middle and hind coxae with gold and black setae and linear gold scales.

Wing (Plate 5*c*) mostly hyaline, cells C and Sc, extreme bases of cells R, M, 1A, and 2A, small spot below base of vein R_5 and base of wing grayish brown. Sectoral crossvein present; vein R_4 evenly curved at medial angle; cell R_{2+3} narrow, less than half as wide medially as apically; r–m crossvein located at basal third of cell $1M_2$, vein R_{2+3} arising slightly basad of r–m crossvein; contact of cells $1M_2$ and Cu_1 more than twice as long as width of base of cell Cu_1; posterior part of wing narrowed, cell 2A narrower than cell 1A, but not incurved; alula greatly reduced, posterior margin straight. Opening of anal cell half the width of r–m crossvein. Halter brown, knob brown above except at extreme tip, yellow below except on margins.

Fore and middle femora with cuneate gold and yellow scales posteriorly, mixed gold and black scales anteriorly; hind femur with black scales along ventral margin and apically, with yellow scales elsewhere. Fore and middle tibiae with black scales anteriorly and gold and yellow scales posteriorly; hind tibia with black scales and a few yellow ones basally. Middle femur with three or four weak macrochaetae anteroventrally toward base and one or two strong macrochaetae postmedially on anterior side; hind femur with a row of weak macrochaetae anteroventrally; fore femur with a postmedial bristle anteriorly. Fore tibia with complete row of macrochaetae anterodorsally; hind tibia with single row of macrochaetae anterodorsally.

Lateral margins of first abdominal tergum with white pile, few gold hairs present posteriorly; lateral margins of terga two through four with sparse black setae and pile, and long, linear, erect, black and gold scales; terga five through seven with gold setae laterally. Discs of terga two through four and medial part of five with linear black scales; posterior margins of one through four with linear and lanceolate gold scales. Remainder of terga with overlapping, ovate and ovate-truncate, shining white scales. Venter with lanceolate white scales and fine, sparse white, yellow, and gold hairs, gold predominating posteriorly.

Male genitalia (Figure 73).—Gonocoxites broad, tapering upward from ventral margins to a sharp apical angle in lateral view, apices with acute lateral angles in ventral view, setae extending about halfway to base, densest medially. Basal segment of gonostylus greatly enlarged and flattened, appearing as a broad, apically rounded, flat plate in ventral view, lateral margin angled upward and medial line raised as a sharp ridge in lateral view. Distal segment of gonostylus formed dorsally to apex of gonocoxites, quadrangular with an outfolded dorsoapical margin and a long truncate basal lobe in lateral view, with a short, truncate lobe apicolaterally and a broad, lanceolate, acute lobe basolaterally in ventral view. Apex of epiphallus with a rounded medial part dorsally from which long, upcurved, sharp horns extend laterally; ventrolateral part broad and rounded apically in lateral view, with medial longitudinal fold. Dorsal bands united mesally, with a hump just after the junction, without setae. Base of aedeagus bulbous, bent sharply downward apically; junction with basal bands not visible in lateral view.

Variation.—The bristles on the coxae may be predominantly black. The scales on the femora and tibiae may be more extensively black than in the type.

Distribution.—This species is known only from the three specimens listed below, although it probably has a wider range throughout the mountains of southern Mexico. The holotype and one paratype were collected "hovering on sunny side of cement culvert."

Holotype.—♂, 25 mi. S Iguala, Guerrero, IX–14–1963, 2400 feet (R. H. and E. M. Painter) (RHP).

PARATYPES.—Mexico: *Guerrero*, ♂, 25 mi. S Iguala, IX–14–1963, 2400 feet (R. H. and E. M. Painter) (NLM). *Morelos*, ♂, 3 mi. N Alpuyeca, V–9–1959, 3400 feet (H. E. Evans) (RHP).

DISCUSSION.—If the female of *innubilipennis* differs from the male in the same way that the female of *delicatulus* Walker differs from the male of that species, it probably lacks the sectoral crossvein and has the wing more extensively pigmented. The presence of a postmedial bristle on the anterior side of the middle femur should serve to separate it from other related species from Mexico.

Anthrax delicatulus Walker

Anthrax delicatulus Walker, 1849, p. 266 [*delicatula*].—Osten Sacken, 1858, p. 39 (*delicatula*).—Aldrich, 1905, p. 230 [*delicatula*].—Painter and Painter, 1962, p. 73.

FEMALE.—Body black, tibiae reddish brown; integument brown to blue green pruinose, margins of eyes, face and lower half of occiput white pruinose. Front with black setae. Face with mixed black and white setae. Occiput with black setae and linear scales on upper third, with white setae and linear scales on lower two-thirds; fringe of hairs on posterior margin black exteriorly and white interiorly on upper third, white below. First antennal segment about 1.5 times longer than apical width; second segment globular; base of third segment flattened laterally, about as wide as second segment in lateral view, tapering abruptly to styliform part which is slightly shorter than base and about 1.5 times longer than style (Figure 108).

Disc of mesonotum with linear black scales; lateral margin in front of base of wing and posterior margin with long, linear white scales. Scutellum with linear black scales. Mesopleuron, sternopleuron, and anterior half of pteropleuron with fine yellow setae and long, linear, white scales, some coarse yellow setae above on mesopleuron and pteropleuron, and some white pile anteriorly on mesopleuron. Prosternum, propleuron, and anterior margin of mesonotum with white pile; postalar tuft of pile mixed black and white. Metapleuron with large patch of linear white scales posteroventral to spiracle; hypopleuron with small patch of white scales and hairs anteroventrally. Coxae with mixed black and white setae, and linear white scales.

Wing (Plate 5*b*) brown anteriorly and basally, hyaline posteriorly; pigment filling cells C, Sc, and R_1, extending from tip of cell R_1 across tip of cell R_{2+3} into tip of cell R_4, filling cell R_{2+3} beyond and into base of cell R_4, cell R_5 filled to base of cell R_4 and extending faintly along base of cell M_1; cell $1M_2$ pigmented basally and along anterior margin three-fourths of way to apex; basal fifth of cell Cu_1 and extreme base of cell $2M_2$ pigmented, pigment extending basally from cell Cu_1 to posterior margin near base of cell 2A, leaving apical fifth of cell 1A and posteroapical two-thirds of cell 2A hyaline. Sectoral crossvein incomplete, base of cell R_4 angled and with long spur, medial angle slightly recurved and sharply bent forward. R–m crossvein at basal third of cell $1M_2$, vein R_{2+3} arising opposite. Contact of cells Cu_1 and $1M_2$ three times as long as width of base of cell Cu_1. Posterobasal margin of wing reduced, but margin not incurved, cell 2A as wide as cell 1A preapically; alula greatly reduced, posterior margin straight. Stigmatic area lightly pigmented. Calypter pigmented, fringe of hairs black. Halter dark brown, knob black, extreme tip lighter.

Fore and middle femora with cuneate white scales posteriorly and black scales anteriorly; hind femur with white scales on basal half posteriorly and at base anteriorly, remainder with black scales. Fore and middle tibiae with yellow and white scales posteriorly and black scales anteriorly; hind tibia with black scales. Middle femur with a large postmedial bristle on anterior side, without bristles anteroventrally; hind femur with row of bristles anteroventrally incomplete basally. Fore tibia with complete row of anterodorsal macrochaetae; hind tibia with single row of anterodorsal bristles.

First abdominal tergum and anterior part of second with white pile laterally, posterior part of second tergum, and third and fourth with black pile, setae and lanceolate scales laterally, some white setae posteriorly on fourth. Hind margin of first tergum with long, linear white scales. Discs of following terga with linear black scales except for patches of lanceolate, truncate, white scales laterally on five and six. Anterior sterna with fine, white and black setae and long, linear and lanceolate, white scales, some medial black scales; posterior sterna with black setae and linear black scales.

MALE.—Similar to female. Wing (Plate 5*a*) less extensively pigmented, pigment not completely filling cell R_1 at apex, filling cells R_{2+3} and R_5 only halfway to base of cell R_4, extending only slightly into bases of cells $1M_2$, Cu_1, and 1A, and leaving Cell M subhyaline

medially and hyaline apically. Sectoral crossvein complete, vein R_4 strongly sinuate medially; contact of cells $1M_2$ and Cu_1 about 1.66 times longer than width of base of cell Cu_1; posterior part of wing less narrowed than in female, cell 2A wider than cell 1A postmedially. Middle femur with several macrochaetae anteroventrally. Last three abdominal terga with overlapping ovate scales with bifid apices. Posterior sterna with lanceolate white scales.

MALE GENITALIA (Figure 74).—Gonocoxites very broad in ventral view, with a preapical fold, tapering concavely to acute, upcurved apices in lateral view; apices broad, sharply rounded apically in ventral view, mesal margin rounded to narrow mesal sulcus; setae very sparse and coarse basad of preapical fold, finer and more dense apically. Basal sclerite of gonostylus very small, not visible in lateral or ventral view, with long setae apically; distal segment with a long, sharp, slightly outcurved, mesal lobe and a shorter, broader lateral lobe, fine setae at base and on lateral lobe. Apex of epiphallus flattened dorsoventrally, apex broadly rounded, a short, sharp lobe curving upward and backward from each side; a flat longitudinal plate extending ventrally under lateral lobes. Dorsal bands united medially, with numerous setae. Base of aedeagus narrow, tapering irregularly to junction with ventral bands below junction of dorsal bands; ventral bands with a pouchlike protuberance halfway to apex.

DISTRIBUTION.—Only two specimens of this species are available, a female in excellent condition from Clarendon, Portland Ridge (N. side), Jamaica, West Indies, VII–19–1958 (T. H. Farr) and a male missing the head and anterior part of the thorax from San Lorenzo, Dominican Republic, VI–27–29–1915.

TYPE.—According to Painter and Painter (1962) the type female of *A. delicatulus* is in the British Museum. It is well preserved except that the head is missing. The type-locality is Jamaica.

There is some doubt about the association of this male and female. Because the two specimens are similar in all respects except the wing pattern and venation and because a similar sexual dimorphism occurs in the closely related *A. angustipennis* Macquart, the male and female are regarded here as the same species.

The male of *A. delicatulus* may be separated from the male of *A. innubilipennis* by the heavier infuscation of the wings. Both males and females may be distinguished from other closely related species by a postmedial bristle on the anterior side of the middle femur.

Anthrax macquarti d'Andretta and Carrera

Anthrax leucopygus Macquart, 1855, p. 76 [*leucopyga*].—Kertész, 1909, p. 43 [*leucopyga*] [not Macquart, 1840; preoccupied].

Anthrax macquarti d'Andretta and Carrera, 1952, p. 296.

MALE.—Body black; integument mostly grayish and brownish pruinose, eye margins and lower part of occiput silver pruinose. Front with black setae and lanceolate black or mixed black and white scales; face with black, yellow or white setae extending almost to antennae. Occiput with black, white or mixed setae and linear scales, fringe of hairs on posterior margin white, black, or black above and white below. First antennal segment about as long as apical width; second segment globular; base of third segment flattened laterally, slightly wider than second segment in lateral view, narrowing abruptly to styliform part which is about as long as base and about 1.6 longer than style (Figure 113).

Discs of mesonotum and scutellum with fine black setae and linear scales; gold scales sometimes in front of base of wing, along posterior margin on mesonotum, and anteriorly and laterally on scutellum; white scales often present laterally on mesonotum and posteriorly on scutellum. Sternopleuron, lower half of mesopleuron, and anterior half of pteropleuron with fine black or white setae and linear scales. Upper half of mesopleuron, prosternum, propleuron, and anterior margin of mesonotum with white, or mixed black and white pile. Postalar tuft of pile black, gold or mixed. Hypopleuron and metapleuron bare. Coxae with coarse black setae and black or white, linear and lanceolate scales.

Wing (Plate 5*k*) dark brown basally, hyaline apically, pigment entirely filling cells C and Sc, extending out to a line running from a point on vein R_1 basal to tip of Sc obliquely across cells R_1 and R_{2+3}, basally almost to r–m crossvein, posteriorly to extreme base of cell $2M_2$, and thence to posterior margin leaving apices of cells 1A and 2A hyaline for a distance equal to twice width of r–m crossvein, a small pigmented area extending from cell R_{2+3} into cell R_5 postbasally. Base of cell R_4 angled; r–m crossvein located at basal third of cell $1M_2$; contact of cells $1M_2$ and Cu_1 slightly less or slightly more than width of base of cell Cu_1, apex of cell 1A punctiform or narrowly open. Stigmatic areas very lightly pigmented. Alula narrowed, posterior margin straight or slightly convex or concave. Calypter

pigmented, fringe of hairs black, white or brown. Halter brown, knob broadly yellow apically.

Femora and tibiae with cuneate black scales, yellow and white scales often present posteriorly and basally. Middle femur with one to three macrochaetae anteroventrally; hind femur with anteroventral row of macrochaetae incomplete basally; anterodorsal surface of fore tibia with few macrochaetae apically; hind tibia with a single row of macrochaetae anterodorsally.

Lateral margins of first abdominal tergum with white pile, often some black hairs, pile sometimes entirely black; lateral margins of terga two through four with black pile and setae, sometimes white hairs anteriorly on two. Posterior margin of first tergum and discs of terga two through four with fine black setae and linear scales, sometimes long white scales laterally on one; terga five through seven with long, overlapping, lanceolate-truncate, silver scales, linear black scales sometimes present medially on five. Sterna with fine black or black and gold scales, some lanceolate white scales on five and six and sometimes laterally on one and two.

Male genitalia (Figure 70).—Gonocoxites rather broad basally, tapering apically; apices rounded in ventral view; dorsal margins with setae; ventral parts with setae almost to base. Basal segment of gonostylus flattened dorsally in lateral view, rounded apically with a few fine setae in ventral view. Distal segment of gonostylus with a bulbous base (triangular in ventral view) tapering to a styliform apex extending upward and outward; apex sharply curved dorsolaterally; ventral part of base with fine setae. Dorsal part of apex of epiphallus raised above ventrolateral parts, cuneate apically, spatulate basally in dorsal view, convex and sharply pointed basally and apically in lateral view; ventrolateral parts extending downward and backward from dorsal part, apices evenly rounded, not reaching apex of dorsal part. Dorsal bands without setae, imperfectly united apically. Base of aedeagus broad, but not bulbous, tapering gradually to junction with ventral bands beyond junction of dorsal bands.

Female.—Similar to male. Silver scales on posterior terga restricted to lateral margins of terga five and six.

Female genitalia (Figure 89).—Tenth tergum with about 22 spines on each side. Ventral arm gradually tapering to acute apex. Dorsomedial angle of sclerite on each side of gonopore sharply produced dorsomedially; lateral arm narrow, sharply pointed distally and curled under below; ventral arm narrow, parallel sided and nearly straight. Each spermathecal duct about 1.5 times longer than bulb; first sections very short; second section about two-thirds as long as third section which is nearly as long as bulb, slightly curved and expanded apically; bulb elongate oval, about twice as long as maximum width, slightly curved and darker than third section of duct.

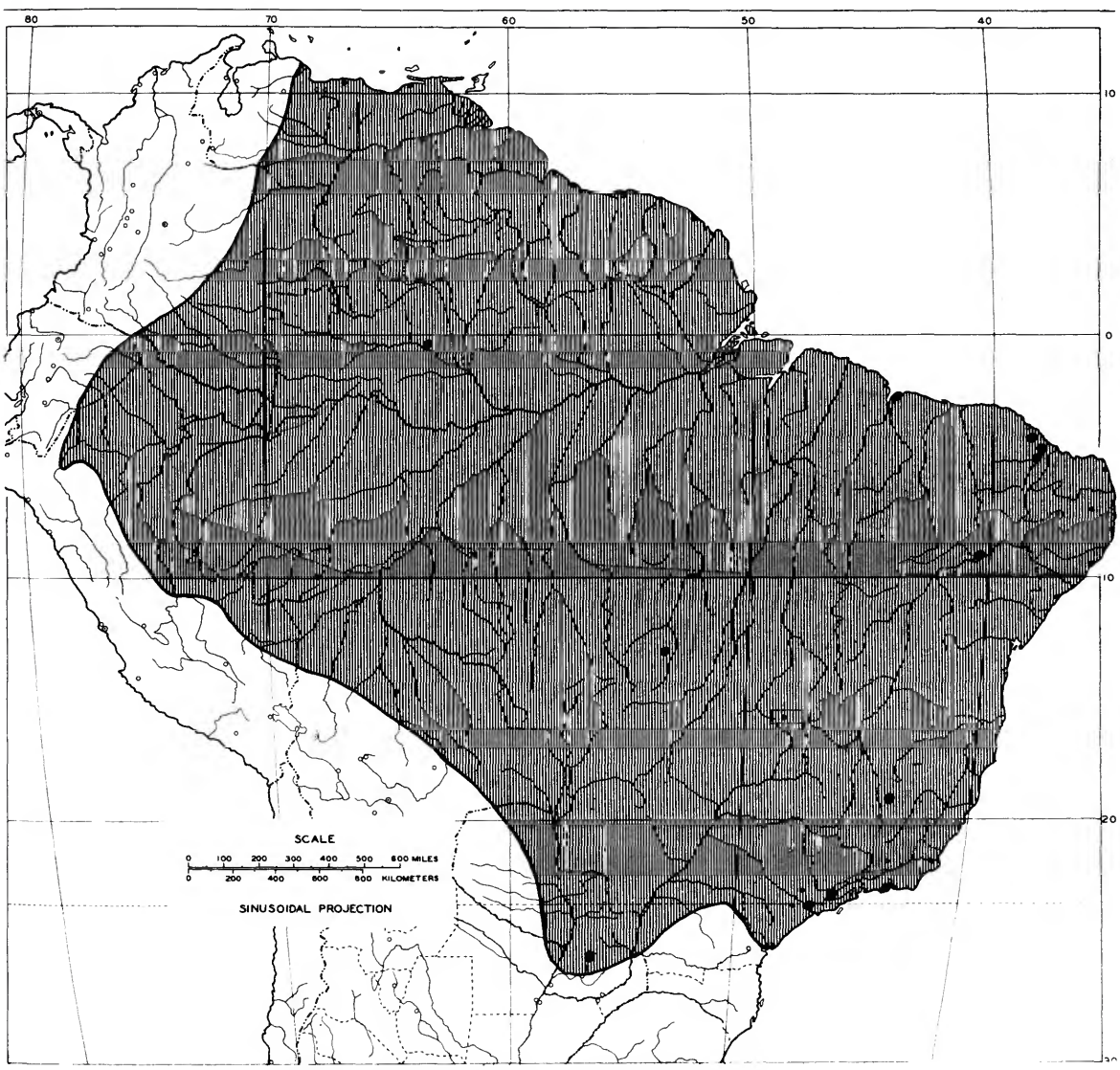
Distribution and ecology.—*Anthrax macquarti* occurs in northeastern South America as far south as the state of São Paulo in Brazil and into central Paraguay (Map 21). A specimen from the Rio Negro in Amazonas indicates that it probably occurs throughout the Amazon Basin.

Two specimens of this species were collected by the author in Rio de Janeiro, Guanabara, Brazil: one at Serro, Minas Gerais, and one at Petrolina, Pernambuco. The specimens from Rio de Janeiro and Serro were collected in open areas in tropical forest. One of the specimens was observed ovipositing in a steep bank. The specimen from Petrolina was collected in an open sandy area near the Rio São Francisco where the vegetation was typical of the semidesert areas of northeastern Brazil. These observations indicate that the distribution of *macquarti* is not limited to certain vegetation zones as are many species of Bombyliidae.

Type.—Painter and Painter (unpublished notes) found that the three specimens associated with the name *Anthrax leucopygus* Macquart in the Bigot collection in the British Museum represented three species. A female agreeing with Macquart's description and figure was considered the type and so marked. It is headless and has several legs missing but is otherwise in good condition. A photograph of the wing and redescription indicate that the type represents the species described herein.

Macquart (1840) described another species which he named *Anthrax leucopygus* from Timor, making *leucopygus* Macquart, 1855, a junior homonym. D'Andretta and Carrera (1952) proposed the name *macquarti* for this species, although the specimen which they considered to be *leucopygus* was actually a specimen of *A. midas* Fabricius. According to Mayr, Linsley, and Usinger (1953, Appendix G), it was ruled at the Fourteenth International Congress of Zoology in Copenhagen "that a substitute name ('nom. nov.') which is in part also based on particular specimens applies in all circumstances to that which the previously published name is applicable." Thus, the name *macquarti* is to be applied as a new name for *leucopygus* Macquart, 1855, rather than being a synonym of *midas* Fabricius.

DISCUSSION.—*Anthrax macquarti* exhibits a broad range of variation. Specimens from the semidesert and desert areas of northeast Brazil have much more extensive white pile on the thoracic pleura and the sides of the abdomen, and the fringe of pile on the posterior margin of the occiput becomes entirely or predominantly white. There are also much more extensive patches of yellow or white scales on the thorax, and the postalar tuft of pile is usually predominantly gold or yellow, as are the setae on the face. Specimens from forested areas have the white pile on the body more or less restricted to the anterior margin of the thorax and the sides of the first abdominal tergum, usually with black, yellow or white scales on the thorax, and have the postalar tuft of pile and the setae on the face black. In the extreme, a male from Serro, Minas Gerais, has only a few white hairs anteriorly on the mesonotum and the usual covering of silver scales on the apical



MAP 21.—Distribution of *Anthrax macquarti*.

369-673 O—70——6

abdominal terga. The wing patterns are much the same throughout the range although those from drier areas tend to be less extensive. The genitalia of males from the two areas appear almost identical.

If long series are acquired from various populations throughout the range, it may be possible to differentiate subspecies. With the limited material now available and lack of definite gaps in the range of variation, however, it seems best to regard all of the populations as a single taxon.

Anthrax macquarti may be separated readily from *repertus, clinopictus,* and *gideon* by the straight or slightly concave margin of the alula and by the postbasal spot extending from cell R_{2+3} into cell R_5 and isolating a small basal hyaline area. The relationship between *macquarti* and *angustipennis* is discussed under the latter species.

Anthrax austrinus, new species

FEMALE.—Body generally black, femora reddish brown basally and yellow apically, tibiae yellow; integument mostly brownish pruinose; lower part of occiput and margins of eyes silver pruinose. Front with black setae and lanceolate black scales, some white scales laterally below. Face with black setae extending almost to antennae, some white hairs below. Upper third of occiput with short black setae; lower two-thirds with black and white setae, the white predominant posteriorly, and white scales; fringe of pile on posterior margin black on upper third, becoming white on lower two-thirds. First antennal segment about as long as apical width; second segment globoid, slightly flattened apically, about as wide as base of third segment in lateral view; basal part of third segment flattened laterally, narrowing abruptly to styliform part which is slightly longer than base and about twice as long as style (Figure 114).

Disc of mesonotum and scutellum with fine black setae and linear scales, mixed black and orange brown on anterior and lateral parts of mesonotum, and posterior margin of scutellum, black elsewhere; lateral margins of mesonotum with coarse setae and linear, semierect, mixed white and orange-brown scales. Sternopleuron and anterior half of pteropleuron with fine black setae and linear gold scales, some coarse black setae dorsally on pteropleuron; mesopleuron with white pile anterodorsally and black setae and white scales posteroventrally. Pile on prosternum, propleuron, and anterior margin of mesonotum white, some black setae on latter; postalar tuft of pile black. Anterior coxa with black and white bristles and white scales; middle and hind coxae with black bristles and gold scales. Hypopleuron bare; metapleuron with several white scales behind spiracle.

Wing (Plate 5*l*) dark brown basally, hyaline apically, pigment extending out to a line running from after tip of Sc irregularly to vein M_{1+2} before base of cell M_1, basally for distance equal to r–m crossvein, back to vein R_{4+5} and basally leaving hyaline spot basally in cell R_5, posteriorly from a point distal to r–m crossvein across extreme base of cell $2M_2$ to vein 2A before its apex, anteriorly again, leaving a hyaline area subapically in cell 1A, and thence to posterior margin two-thirds of way to apex of cell 2A. Vein R_4 sharply angled basally; r–m crossvein located two-fifths of distance from base to apex of cell $1M_2$; base of vein R_{2+3} located basad to r–m crossvein slightly less than width of that crossvein; contact of cells $1M_2$ and Cu_1 slightly greater than width of base of cell Cu_1; cell 1A punctiform apically. Alula narrowed, the posterior margin straight. Halter light brown, knob yellow tipped dorsally and mostly yellow ventrally.

Fore and middle femora with mixed yellow and white cuneate scales posteroventrally and black scales anterodorsally; hind femur with yellow and white scales basally and black scales apically; fore and middle tibiae with yellow scales posteriorly and mixed gold and black scales anteriorly; hind tibia with mixed gold and black scales. Middle femur with one to three strong macrochaetae anteroventrally; hind femur with five to seven strong macrochaetae anteroventrally; fore tibia with macrochaetae distally on anterodorsal side; hind tibia with single row of macrochaetae anterodorsally.

First abdominal tergum with white pile laterally; terga two through four with black pile laterally, some white hairs and scales posteriorly on four; terga five and six with long, narrow, silvery-white scales and black setae laterally; seventh tergum with only black setae laterally. Posterior margin of first tergum and discs of remaining terga with fine black setae and linear black scales; some linear, orange-brown scales on posterior margins and some yellow and white scales posterolaterally. Abdominal sterna with fine white and gold setae and linear black scales; numerous white, yellow and orange-brown scales posteriorly and laterally on all segments.

MALE.—Similar to female. Lateral fourths of fifth abdominal tergum, most of sixth tergum and all of seventh with posteriorly produced, long, lanceolate-truncate, overlapping, white scales.

MALE GENITALIA (Figure 71).—Gonocoxites narrow, dorsal margins curving concavely to sharply rounded apices in lateral view; apices narrowly rounded in ventral view with blunt ridges medially, medial sulcus narrow; setae sparse, short, extending basally halfway from medial fold to base. Basal segment of gonostylus sinuate dorsally in lateral view, blunt apically in ventral view, with fine setae apically. Distal segment of gonostylus round basally, tapering apically, styliform part projecting upward and outward, apex curved dorsolaterally; base with fine setae ventrally and laterally. Apex of epiphallus with a raised dorsal plate which is right angled basally and slightly emarginate apically in dorsal view; ventrolateral part curved downward and inward, rounded below, straight apically in lateral view, extending slightly past middle of dorsal plate. Dorsal bands united mesally, with three small setae. Base of aedeagus tapering conically to junction with ventral bands below junction of dorsal bands.

VARIATION.—The only other specimen available of this species is similar in all respects to the holotype.

DISTRIBUTION.—*Anthrax austrinus* is known from only two localities, Nova Teutonia, Santa Catarina, and "Granja Carola," Rio Grande do Sul, Brazil. It probably occurs in forested areas from Paraná southward.

HOLOTYPE.—♀, Nova Teutonia, Santa Catarina, Brazil, 27°11′S, 52°23′E, XII–1–1938 (Fritz Plaumann) (BM).

PARATYPES.—Brazil: *Rio Grande do Sul,* ♂, Granja Carola (Dr. M. Leitão) (NLM). *Santa Catarina,* ♀, Nova Teutonia, 27°11′S, 52°23′E, XII–19–1959 (Fritz Plaumann) (UCAL).

DISCUSSION.—The male paratype is not designated as the allotype, since the head is missing and it has only one leg and one wing. The female paratype lacks one wing and two legs but is otherwise in good condition.

The distinctive wing pattern of this species will serve to separate it from all other species in the *cephus* group from North and South America. The structure of the wings and the male genitalia indicate its close relationship to *macquarti.*

Anthrax repertus Walker

Anthrax repertus Walker, 1852, p. 188.—Kertész, 1909, p. 52.
Anthrax inexactus Walker, 1857, p. 140.—Kertész, 1909, p. 42.
Anthrax analis.—Macquart, 1840, p. 345 [not Say, 1823].

MALE (TYPICAL).—Body mostly black, femora and tibiae reddish brown or black; integument brownish pruinose. Front with black setae and lanceolate black scales, sometimes a few lateral yellow scales. Face with black setae extending to antennae, a few black or white scales below. Occiput with sparse black setae and lanceolate or linear black scales, sometimes a few yellow scales; fringe of pile on posterior margin black. First antennal segment about as long as apical width; second segment globular; base of third segment slightly compressed laterally, about equal to second segment in lateral view, narrowing abruptly to styliform part which is about 1.5 times longer than base and about 3 times longer than style (Figure 119).

Mesonotum and scutellum with fine black setae and linear black scales, longer and suberect laterally on mesonotum; a few white or yellow lateral scales on mesonotum and scutellum. Mesopleuron, sternopleuron, and anterior part of pteropleuron with black setae, pile, and scales. Pile on prosternum and propleuron black, on anterior margin of mesonotum mixed black and white; postalar tuft of pile black or mixed black and white. Hypopleuron and metapleuron bare. Coxae with black setae and black scales.

Wing (Plate 4*j*) light or dark brown basally, hyaline apically, pigment typically extending out as far as base of cell R_4 in cell R_1, two-thirds of way from base of R_{2+3} to base of R_4 in cells R_{2+3} and R_5, one-third of way from r–m crossvein to base of M_1 in cell $1M_2$, extreme base of cell $2M_2$, and thence running to posterior margin in cell 2A, leaving cells 1A and 2A hyaline apically for a distance up to two times length of r–m crossvein. Stigmatic area lightly pigmented. Base of cell R_4 evenly rounded. R–m crossvein located at basal third or two-fifths of cell $1M_2$; contact of cells $1M_2$ and Cu_1 slightly longer to slightly shorter than base of cell Cu_1. Cell 1A closed and sometimes petiolate. Alula distinctly rounded posteriorly. Calypter lightly pigmented, fringe of hairs white. Halter dark brown, tip of knob yellow.

Scales on legs cuneate and black; sometimes a few yellow scales on femora and more often on tibiae. Middle femur without macrochaetae anteroventrally or with only one or two; hind femur with three to five macrochaetae anteroventrally. Fore tibia with a com-

plete row of small macrochaetae anterodorsally; hind tibia with single row of macrochaetae anterodorsally.

Pile laterally on first abdominal tergum black, white or mixed; on terga two, three, and four black; some white or yellow setae sometimes present on four; terga five, six, and seven with white or black setae and some white scales laterally. Discs of terga one through four with hairlike black scales and fine setae; some cuneate lateral white scales on four, some linear yellow scales sometimes posteriorly on anterior terga. Discs of terga five and six with yellow or white setae and cuneate or lanceolate scales, yellow or white posterolaterally, black anteromedially; scales on seventh tergum entirely white or yellow, or black scales intermixed medially. Abdominal sterna with fine black setae and hairlike black scales, sometimes a few yellow posterior scales.

Male genitalia (Figure 65).—Gonocoxites broad, dorsal margins tapering convexly to acute apices in lateral view; apices rounded apically in ventral view, mesal margins rounded, mesal sulcus narrow; setae on gonocoxites sparse, evenly distributed basally beyond medial fold. Basal segment of gonostylus sharply angled basally, rounded apically, concave dorsally before apex; distal segment rounded basally, somewhat laterally flattened, with a styliform apical part arising from the dorsal half and slightly curving upward and outward distally; sparse setae on ventrolateral surface. Apex of epiphallus with slightly convex, raised dorsal plate formed at about a 30° angle, the plate right angled basally and slightly rounded apically in dorsal view, curved downward laterally; ventrolateral part broadly rounded ventrally, extending apically as far as middle of dorsal plate. Dorsal bands united mesally. Aedeagus narrow basally, gradually tapering to junction with ventral bands below junction of dorsal bands.

Female.—Similar to male. Femora sometimes yellowish. Pigmentation of wing more extensive, reaching apex of vein R_1 in cell R_1, base of cell R_4 in cell R_{2+3} and base of cell M_1 in cell R_{4+5}. Light scales on abdomen restricted to lateral margins of fourth and sometimes fifth and sixth terga.

Female genitalia (Figure 90).—Tenth tergum with only one spine on each side. Ventral arm of ninth tergum narrow, apex not enlarged. Dorsomedial angle of sclerite on each side of gonopore expanded dorsally and sharply rounded; lateral arm broad, tapering to upturned apex, ventral margin curled under; ventral arm narrow, parallel sided, recurving mesally below. Each spermathecal duct about 2.5 times longer than bulb; first section very short, middle section about 1.5 times longer than straight third section; bulb globoid, symmetrical, slightly contracted just before middle.

Distribution and ecology.—*Anthrax repertus* occurs throughout northeastern South America from Rio Grande do Sul, Brazil, and central Paraguay to the Caribbean Sea, north into Central America as far as Honduras and south along the Pacific coast into Ecuador and Peru (Map 22). Specimens have been collected by the author in Rio de Janeiro, Guanabara; Guaiba, Rio Grande do Sul; and Remanso, Bahia, Brazil. The first locality was a high hill covered with grass in the dominantly tropical forest of eastern Brazil; the second locality was a dry hillside covered with grass and forbs in the predominantly grassland area of southern Rio Grande do Sul; the third area was an open sandy spot near the Rio São Francisco in the "cerrado" of central Brazil.

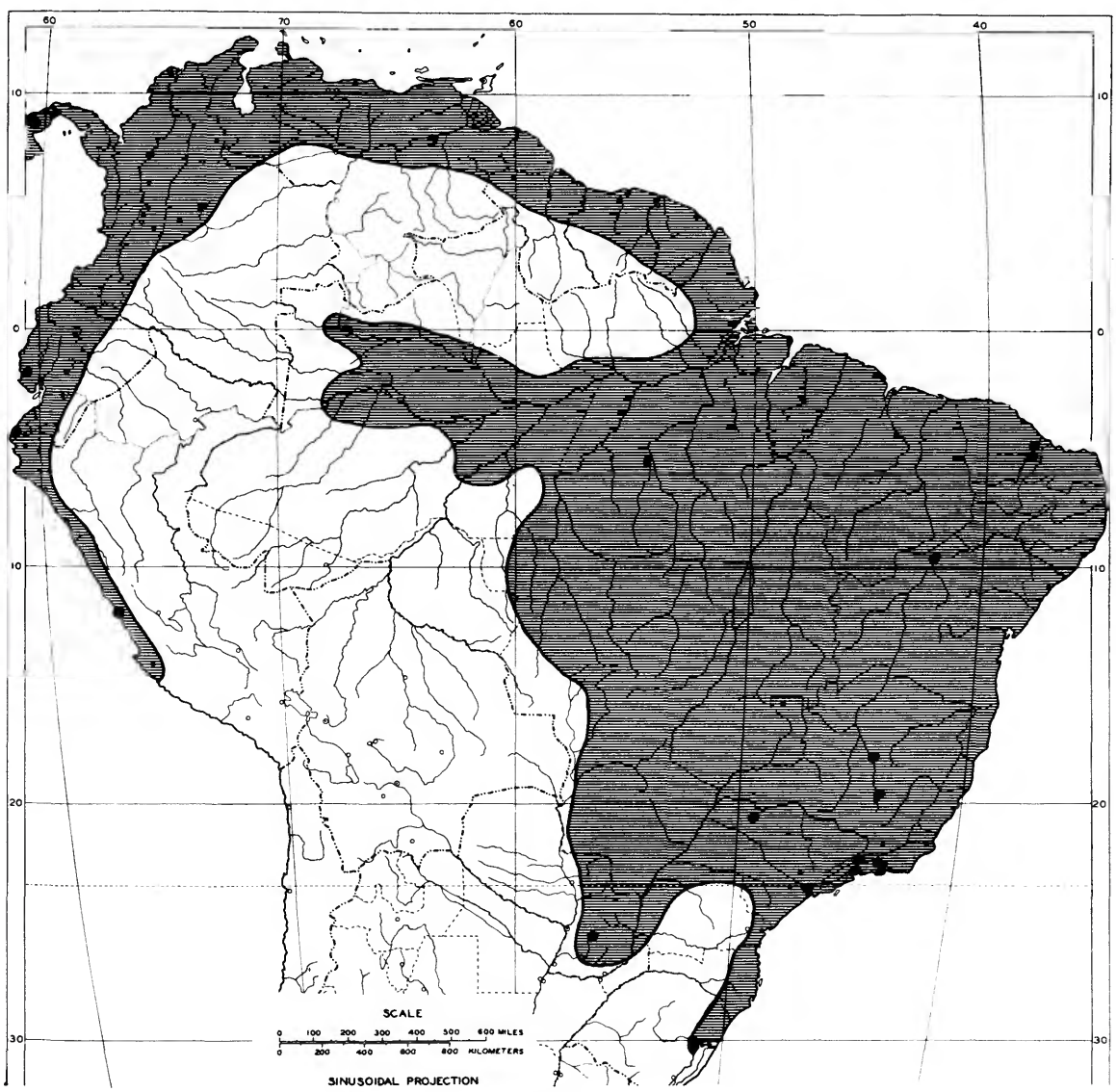
Types.—According to Painter and Painter (unpublished notes) the type female of *Anthrax reperta* Walker is in the British Museum. It carries the green type label with "*A. reperta* Walk." on the back, another "68–4," and another "S. America pres. W. W. Saunders, B. M. 1868–4." The head has been glued on, but otherwise the type is well preserved. The photograph of the wing and redescription of the type show it to be a typical specimen of the taxon described here.

The type of *Anthrax inexactus* Walker is also in the British Museum. According to notes made by Painter and Painter, the body is greasy and covered with fungus and dust, the wings are mounted on a celluloid square below the specimen, the head is glued on sideways, and the antennae and four and a half legs are missing. It carries the green type label, another label "Amaz," another "68–4," and a folded label with "*inexacta* Wlk." in Walker's handwriting. A photograph of the wing and redescription indicate that this specimen falls within the range of variation of *repertus*.

Discussion.—Like *macquarti, repertus* exhibits extensive variation throughout its range. The most marked difference is in the color of the scales and pile on the body. In one extreme, a male from Guaiba, R. G. S., Brazil, has only a few white hairs on the anterior margin of the mesonotum, a few white scales on the posterior abdominal terga, and the normal white fringe on the calypteres. In the other extreme, a specimen from Remanso, Bahia, Brazil, has all of the black hairs and scales on the body replaced by yellow ones. A specimen from Limoeiro, Ceará, is intermediate between the typical form and the specimen from Remanso. Specimens from the coastal area of Peru

also have numerous yellow scales and hairs on the body. In this case, two specimens from Ecuador are intermediate between the typical and light-colored forms.

The extent of the wing pattern is also highly variable. Specimens from areas of high humidity and rainfall usually have a pattern similar to that described above. In some cases, however, the pattern may be much more extensive, reaching the apex of cell R_1, extending into the base of cell R_4 and extending past the base of cell M_1 in cell R_5. Apparently, a specimen with a pattern like this served as type for Walker's *inexactus* which was described from the "Valley of the Amazon." The only specimen studied from the lower Rio Amazonas has wings with only slightly more extensive pigment than that described for the typical form. At the other extreme, specimens from desert areas have less extensively pigmented wings. In this



MAP 22.—Distribution of *Anthrax repertus*.

case, the pigment may extend apically only one-third of the way from the r–m crossvein to the base of cell R_4 in cells R_{2+3} and R_5, and may extend in cell R_1 only halfway from the r–m crossvein to its tip. In these specimens the pigment is also less extensive posteriorly, leaving as much as the apical third of cells 1A and 2A hyaline.

As in *macquarti,* this variation seems to be correlated with climate, those species from drier areas having less extensive wing pigment and lighter scales and hairs. Although some of the variants may represent distinct species or subspecies, further collecting will be required to determine their true relationship. Since describing the variants from only one or a few specimens now would complicate the work of future students, the entire range is included here under *repertus.*

Two additional distinctive specimens closely related to *repertus* have been studied by the author. One, a female from Lagoa Santa, Minas Gerais, Brazil, in the collection of the author, has the margin of pigment on the wing extending from below the tip of vein Sc across the base of cell R_5 to the base of cell Cu_1 and thence basally, leaving the apical third of cell 1A and all but a narrow area along the anterobasal margin of cell 2A hyaline. This specimen also has the pile and scales on the thoracic pleura entirely white and has some linear gold scales on the mesonotum, scutellum, and posterior margin of the first abdominal tergum.

The other, also a female, is from Rio de Janeiro and is in the collection of the Instituto Oswaldo Cruz. It has the wing distinctly broader than in typical specimens of *repertus* and has the pigment entirely filling cells 1A and 2A and extending out to the apical fourth of cell Cu_1, whereas anteriorly it reaches only as far as the tip of vein Sc. The margins of the front are nearly parallel. It is much smaller than typical specimens of *repertus,* the wing length being only 5.7 mm.

Anthrax repertus may be readily separated from *analis* and *gideon* by the hyaline apices of cells 1A and 2A. It differs from *macquarti* and *austrinus* in having the posterior margin of the alula distinctly rounded. The relationship of *repertus* and *clinopictus* is discussed under the latter species.

Anthrax clinopictus, new species

MALE.—Integument mostly black, brownish pruinose, femora and tibiae yellow. Front with black setae and lanceolate gold scales. Face with black setae extending almost to antennae, a few linear yellow scales below. Setae on occiput black around vertex, yellow elsewhere, scales gold; fringe of hairs on posterior margin yellow below, black exteriorly and yellow interiorly above. First antennal segment about as long as apical width; second segment globular, about as wide as base of third segment in lateral view; base of third segment slightly compressed laterally, narrowing abruptly to styliform part which is about 1.5 times as long as base and about twice as long as style (Figure 118).

Disc of mesonotum with fine black setae and mixed black and gold, linear scales; lateral margins with linear, semierect gold scales. Disc of scutellum with fine black setae and mixed black and white, linear scales; posterior and lateral margins with linear gold scales. Mesopleuron, sternopleuron, and anterior half of pteropleuron with fine, black and gold setae, and linear gold scales; some coarse black and gold setae and yellow hairs above on mesopleuron and pteropleuron. Pile on prosternum and propleuron mixed yellow and brown, yellow predominating on prosternum; pile on anterior margin of mesonotum mixed yellow and white; postalar tuft of pile yellowish white. Coxae with black setae and linear gold scales. Hypopleuron and metapleuron without scales or setae.

Wing (Plate 4*h*) dark brown basally, hyaline apically, the pigment filling all of cell R_1, cell R_{2+3} past base of cell R_4, cell R_5 to base of cell M_1, basal three-fifths of cell $1M_2$, extreme base of cell $2M_2$, and cell Cu_1 out to base of cell $2M_2$, leaving apices of cells 1A and 2A hyaline for a distance twice length of r–m crossvein. Stigmatic area very lightly pigmented. Base of vein R_4 evenly rounded; r–m crossvein placed at basal third of cell $1M_2$; base of vein R_{2+3} slightly basad of r–m crossvein; contact of cells $1M_2$ and Cu_1 about equal to base of cell Cu_1; cell 1A punctiform apically. Alula rounded posteriorly. Calypter lightly pigmented, fringe of hairs white.

Scales on femora and tibiae cuneate and lanceolate, yellow ventrally, mixed yellow and black dorsally. Middle femur without macrochaetae anteroventrally; hind femur with two to four macrochaetae anteroventrally; fore tibia with a row of small macrochaetae anterodorsally; hind tibia with a single row of macrochaetae anterodorsally.

First abdominal tergum with white pile laterally; terga two through four with black hairs and setae laterally, some yellow hairs present posteriorly on four; terga five through seven with black and yellow setae laterally. Posterior margin of terga one through three with linear gold scales posteriorly, some long, white

and yellow, lanceolate scales laterally; remainder of discs of terga two and three, and anterior half of fourth tergum with hairlike black scales; terga five through seven and posterior margin of fourth tergum with ovate-truncate and lanceolate, white or yellowish-white scales, the darker scales anterior on the segments, some linear gold scales intermixed. Venter with sparse yellow setae and linear and lanceolate gold scales, a few black scales anteriorly on the segments.

MALE GENITALIA (Figure 62).—Gonocoxites broad, dorsal margins broadly rounded to sharp apices in lateral view, rounded mesally to narrow mesal sulcus; apices sharply rounded in ventral view; setae sparsely distributed basally beyond medial fold. Basal segment of gonostylus convex dorsally in lateral view; distal segment bulbous basally, with styliform apex extending outward and upward from dorsal side, apex curved dorsolaterally, sparse setae lateroventrally. Apex of epiphallus with a raised dorsal plate convex dorsally in lateral view, angulate basally and slightly emarginate apically in dorsal view, ventrolateral part curled upward below, extending past middle of dorsal plate. Dorsal bands united mesally. Base of aedeagus narrow, tapering to junction with ventral bands below junction of dorsal bands.

FEMALE.—Similar to male. Yellow and white scales restricted to lateral parts of posterior abdominal terga, centers of discs with anterior linear black scales and posterior linear gold scales.

FEMALE GENITALIA (Figure 91).—Tenth tergum with eight spines on each side. Ventral arm of ninth tergum undulate and not enlarged apically. Dorsomedial corner of sclerite on each side of gonopore produced dorsally as a narrow, apically rounded lobe; lateral arm short, turned upward to extreme apex which is bent posteriorly. Each spermathecal duct about four times longer than bulb; first section very short; second section about two-thirds as long as apical section which is about twice as long as bulb and expanded distally; bulb asymmetrical, elliptical with apex bent to one side, and not well defined from duct.

VARIATION.—The scales on the front may be yellow rather than gold and there may be a few dorsal black scales. The setae on the occiput may be entirely black. The scales on the mesonotum vary from light to dark gold. The hairs on the prosternum may be entirely yellow or predominantly light brown. The middle femur may have two or three macrochaetae anteroventrally.

DISTRIBUTION.—Specimens of *clinopictus* have been collected from several localities in São Paulo, and from western Paraná and northern Argentina. It probably also occurs in southern Minas Gerais and possibly in southwestern Rio de Janeiro. A typical specimen of *repertus* was collected along with *clinopictus* at the type-locality.

HOLOTYPE.—♂, Onda Verde, Faz. São João, São Paulo, Brazil, I–1946 (F. Lane) (SASP).

ALLOTYPE.—♀, same data as holotype (SASP).

PARATYPES.—Argentina: ♂, ♀, "Tapikiolé," XII–25–I–26 (Lind.; D. Chaco Exped.) (Staat).

Brazil: *Paraná,* ♂, Iguassú, XII–1941 (Com. E. N. V.) (IOC). *São Paulo,* 2♂, ♀, Onda Verde, Faz. São João, I–1946 (F. Lane) (SASP, NLM); ♂, Perúbe, XII–1946 (M. Carrera) (SASP); ♀, Praia Grande, Faz. Rondonea, II–1945 (M. Carrera) (SASP); ♂, Ubatuba, VI–1955 (F. Lane) (SASP).

DISCUSSION.—The diagnostic characters of *clinopictus* are in all cases ones which occur in one or more of the variants of *repertus.* Only in *clinopictus,* however, are they found in combination. Since this particular combination of characters is found in both males and females at several localities with similar habitats, they likely represent a genetic population distinct from *repertus.* Since a typical specimen of *repertus* was collected along with specimens of *clinopictus* at the type-locality and no intermediates have been seen from within the range of *clinopictus,* it is being described as a distinct species.

The male genitalia of *clinopictus* differ from those of *repertus* in that the ventral margin of the ventrolateral part of the apex of the epiphallus is curled outward and upward. The female genitalia differ in having nine bristles on each side of the tenth tergum, rather than only one, and in having the bulb of each spermatheca asymmetrical.

Anthrax gideon Fabricius

Anthrax gideon Fabricius, 1805, p. 124.—Wiedemann, 1828, p. 311.—Macquart, 1840, p. 342.—Osten Sacken, 1858, p. 40.—Curran, 1934, p. 363.—Wolcott, 1951, p. 450.

Argyramoeba gideon.—Schiner, 1868, p. 122 [*Argyromoeba*].—Osten Sacken, 1878, p. 90.—Kertész, 1909, p. 64.

Spongostylum gideon.—Aldrich, 1905, p. 233 [*Spogostylum*].—Johnson, 1913, p. 56 [*Spogostylum*].

Anthrax acroleucus Wiedemann, 1828, p. 312 [*acroleuca*].—Curran, 1934, p. 363 [*acroleuca*].

Argyramoeba acroleuca.—Osten Sacken, 1886, p. 101.—Kertész, 1909, p. 59.

Spongostylum acroleucum.—Williston, 1901, p. 275 [*Spogostylum acroleuca*].—Aldrich, 1905, p. 222 [*Spogostylum acroleuca*].—Johnson, 1913, p. 56 [*Spogostylum acroleuca*].
Argyramoeba sp.—Osten Sacken, 1886, p. 101.

MALE.—Integument mostly black, legs and pleura often brown; front, mesonotum, scutellum, and abdominal terga velvet black or brown pruinose, remainder of body brown or gray pruinose. Setae and scales on front black; face with black setae extending to antennae, a few white hairs ventrally. Setae and scales on occiput black; fringe of pile on posterior margin black. First antennal segment about as long as apical width; second segment globular; base of third segment globular (often collapsed), slightly smaller than second segment, narrowing abruptly to styliform part which is about one-half longer than base and about one-third longer than style (Figure 117).

Discs of mesonotum and scutellum with short black setae and threadlike black scales; lateral and anterior margins of mesonotum with longer black hairs, erect linear scales, and black setae. Sternopleuron, mesopleuron, and anterior half of pteropleuron with fine black setae and threadlike black scales, some dorsal long black hairs and coarse black setae on mesopleuron and pteropleuron. Prosternum and propleuron with black pile; postalar tuft of pile black. A patch of black hairs often behind spiracle. Coxae with black hairs, setae, and threadlike scales.

Wing (Plate 4*i*) pigmented velvet black or brown basally, hyaline apically; apical margin of pigment distinct, running from tip of vein R_1 across base of cell R_4 to vein M_1 slightly beyond base of cell M_1, basally on vein R_5 to slightly beyond r–m crossvein and thence curving posteriorly through extreme base of cell $2M_2$ to tip of vein 1A; usually a narrow hyaline area posteriorly in cell R_5. Basal angles of veins R_4 and R_{2+3} without spurs, or having spurs shorter than basal segments of veins. R–M crossvein located at basal third or two-fifths of vein M_{1+2}; contact of cells $1M_2$ and Cu_1 about equal to base of cell Cu_1. Posterobasal part of wing not narrowed, cell 2A slightly wider than cell 1A, alula rounded posteriorly. Apex of wing often milky colored as far back as tip of vein R_1. Stigmatic area heavily pigmented. Calypter pigmented, fringe of hairs usually white in specimens from northern South America and Central America, usually black or brown in specimens from southeast Brazil. Halter brown, extreme tip of knob yellow.

Scales on legs black. Middle femur without macrochaetae anteroventrally or with only one or two short ones; hind femur with three to five weak macrochaetae anteroventrally; hind tibia with single row of macrochaetae anterodorsally.

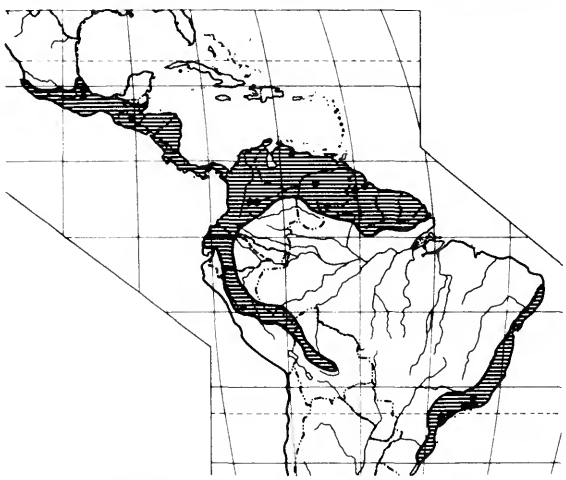
Sides of abdominal terga with dense black pile; sterna and discs of terga with sparse black setae and black, threadlike scales.

MALE GENITALIA (Figure 63).—Gonocoxites broad, dorsal margins curving concavely to ventral margins to form acute apices in lateral view; apices broadly rounded in ventral view, with sharp ridges mesally. Basal segment of gonostylus sharply pointed basally, convex toward apex in lateral view; distal segment round in cross section basally, tapering apically; sharp longitudinal ridge dorsally in lateral view; apex sharply bent upward and outward, or straight in some specimens from eastern Brazil. Setae on gonocoxites extending almost to base, evenly distributed, absent at extreme apices; setae over interior and ventral surfaces of basal part of distal segment of gonostylus. Apex of epiphallus with a basally acute, apically emarginate dorsal plate formed at about a 30° angle; ventrolateral part broad, not extending to apex of dorsal plate; dorsal bands very narrowly separated medially, without setae. Base of aedeagus broad, but not bulbous, tapering only slightly to junction with ventral bands below junction of dorsal bands.

FEMALE.—Similar to male. Fringe of hairs on posterior margin of occiput sometimes white below. Pile on prosternum, propleuron, anterior half of mesopleuron, and anterior margin of mesonotum occasionally partly or wholly white. Apices of wings never milky. Sides of first and anterior half of second abdominal terga often with white pile. Sides of fourth tergum occasionally with a patch of long, overlapping, acute silver scales, and a few white seta.

FEMALE GENITALIA (Figure 94).—Tenth tergum with about 18 spines on each side. Ventral arm of ninth tergum narrow, parallel sided and nearly straight, apex not enlarged. Dorsomedial angle of sclerite on each side of gonopore produced mesally as a short narrow, truncate lobe; lateral arm broad basally, tapering to an acute apex, curled under below; ventral arm narrow and curved sharply inward below. Each spermathecal duct about four times as long as bulb; first section very short; middle section slightly shorter than apical section which is about twice as long as bulb and broadly expanded almost to width of bulb apically; bulb asymmetrical, slightly longer than maximum width, constricted at junction with duct.

DISTRIBUTION AND ECOLOGY.—*Anthrax gideon* occurs from southern Mexico into the Guianas and Bolivia in northwestern South America, and in the Serra do Mar in southeast Brazil (Map 23). Two specimens



MAP 23.—Distribution of *Anthrax gideon*.

were collected by the author in Rio de Janeiro, Brazil, along the edge of an open sand and gravel area in the tropical forest covering the mountainous southwestern part of the city. No specimens of this species have been seen from the Amazon Basin, nor from the extensively collected Barro Colorado Island in the Canal Zone, Panama. This may indicate that *gideon* inhabits areas of greater relief, which would explain its discontinuous distribution.

TYPES.—According to notes made by Painter and Painter, there are two females of *Anthrax gideon* Fabricius in the Universitets Zoologiske Museum, Copenhagen. One carries the red type label only, while the other carries the red type label and another label reading "*A. gideon* ex Am. Mer. Schmidt." A homotype compared with the type is typical of female specimens from Central America and northwestern South America.

Painter and Painter (personal notes) found a series of syntypes of *Anthrax acroleuca* consisting of five males and one female in the Vienna Museum. All are apparently from Brazil. No lectotype was chosen since none of the specimens was perfect nor complete. A homotype compared with the type series is typical of specimens from southeast Brazil.

The type female of *Argyramoeba propinqua* Schiner is in the Vienna Museum. According to notes made by Painter and Painter, it carries the labels "Venezuela" and "*propinqua* Alte Sammlung." The specimen is partly glued together and greasy, with the antennae plastered down or missing, the last pair of legs missing, and one wing broken. The photograph and redescription of the type indicate that it is a typical specimen of the form *propinquus* discriminated below.

DISCUSSION.—*Anthrax gideon* is a highly variable species. In general, however, those from southeast Brazil show much less variation than those from the remainder of the range. Specimens from the coastal area of Brazil usually have the pile and scales on the body entirely black in both sexes, although the pile laterally on the first abdominal tergum is often white in females. The pruinosity on the dorsal parts of the body is velvet black and the wing pigment is velvet black. The wing pattern in this area is quite stable, like that shown in Plate 4*i*.

Specimens from northwest South America, Central America, and southern Mexico, on the other hand, show a wide range of variation. The wing pattern varies from the condition of the form *propinquus* to a condition approaching that of *analis*. The pigment is typically velvet black, but may be brown in specimens from Colombia, Venezuela, and British Guiana. The pruinosity on the dorsal surface of the body also is typically velvet black, but may be brown on those specimens with lighter wings. Many males from the northwest part of the distribution have the fringe of pile on the calypteres white, a condition found in only one Brazilian specimen. The females often have extensive white or yellowish white pile on the anterior part of the thorax and the lateral parts of the first abdominal tergum, and patches of white scales laterally on the fifth tergum.

Throughout the range of *gideon*, some of the males have the apex of the wing milky white rather than hyaline. No females have been examined that show this condition.

Wiedemann (1828) described the Brazilian form with entirely black hairs and scales as *acroleucus*. Since the extent of variation in these characters broadly overlaps in the two areas, they are regarded here as the same species. It seems probable that the population in southeast Brazil was derived relatively recently from an ancestral population in the area of Bolivia with a low incidence of specimens with white pile and scales.

Anthrax gideon f. *propinquus* (Schiner)

Argyramoeba propinqua Schiner, 1868, p. 123.—Kertész, 1909, p. 66.

Two males and two females from Fusagasuga, Cundin Amarca, Colombia, have a wing pattern like that of *Argyramoeba propinqua* Schiner. The pigment extends in cell R_5 more than twice the length of the r-m crossvein past the base of cell M_1 and extends slightly into the base of cell M_1. These specimens agree in all other respects with the redescription of the type made by Painter and Painter. Although no type-locality was given in the original description, the type is labeled "Venezuela." As in the forms of *Anthrax analis,* this form does not diverge in other respects from the normal range of variation in this area. For this reason, and since a male with normal wing pattern has been studied from Caquesa, Cundin Amarca, *propinquus* is regarded here as simply a form of *gideon*. A long series of specimens will be required to determine conclusively the true relationship of the taxa.

The relationship of *gideon* and *analis* is discussed under the latter species. *Anthrax gideon* differs from *funebris* in that the pigment on the wing does not fill more than half of cell $1M_2$, and differs from the other members of the *analis* complex in having cells 1A and 2A entirely pigmented, or with only the extreme apex of cell 1A subhyaline.

Anthrax analis Say

Anthrax analis Say, 1823, p. 45.—Osten Sacken, 1858, p. 39.—Johnson, 1925, p. 108 [*anale*].—Curran, 1927, p. 85.—Painter, 1930, p. 794.—Painter, 1933, p. 5 [*anale*].—Maughan, 1935, p. 32.—Brimley, 1938, p. 341.—Strickland, 1938, p. 195.

Argyramoeba analis.—Osten Sacken, 1877, p. 242.—Osten Sacken, 1878, p. 89.—Osten Sacken, 1886, p. 101.—Coquillett, 1894, p. 95.—Johnson, 1895, p. 325.—Rau, 1926, p. 231 [*Argyromoeba anale*].

Spongostylum anale.—Aldrich, 1905, p. 222 [*Spogostylum*].—Johnson, 1913, p. 55 [*Spogostylum*].—Shelford, 1913, p. 213 [*Spogostylum*].—Malloch, 1915, p. 328 [*Spogostylum*]—Cole and Lovett, 1921, p. 243 [*Spogostylum*].—Cole, Malloch, and McAtee, 1924, p. 185 [*Spogostylum*].

Anthrax georgicus Macquart, 1834, p. 406 [*georgica*].—Macquart, 1840, p. 346 [*georgica*].—Osten Sacken, 1858, p. 40.— Painter and Painter, 1962, p. 75.

Argyramoeba gideon.—Coquillett, 1894, p. 95 [not Fabricius, 1805].

Spongostylum gideon. Aldrich, 1905, p. 223 [*Spogostylum*] [not Fabricius, 1805].

Spongostylum occidentalis.—Johnson, 1913, p. 56 [*Spogostylum*].

MALE.—Body black, tibiae sometimes red or yellow, femora sometimes red; integument light and dark brown pruinose. Front with black setae and scales; face with black setae extending almost to antennae. Occiput with sparse black setae and a few black scales; fringe of hairs on posterior margin black. First antennal segment about as long as apical width; second segment biscuit shaped, flattened apically; base of third segment flattened laterally, narrowing abruptly to styliform part, about as wide as second segment; styliform part about one-half longer than base, two to three times longer than style (Figure 116).

Discs and lateral margins of mesonotum and scutellum with linear black scales. Sternopleuron, lower half of mesopleuron, and anterior part of pteropleuron with black setae and linear black scales; upper half of mesopleuron with black pile and fine and coarse black setae. Prosternum, propleuron, and anterior margin of mesonotum with black pile, some white pile often present on latter; postalar tuft of pile black, or rarely mixed black and white. Coxae with black bristles and scales.

Wing typically dark brown basally, hyaline apically (Plate 3*a*); pigment extending out to a line from tip of vein R_1 across cell R_1 slightly basad along vein R_{2+3} and perpendicularly across cells R_{2+3} and R_5, or diagonally across cells R_{2+3} and R_5 about to bifurcation of vein M_{1+2}, along vein M_{1+2} halfway to r-m crossvein, and thence posteriorly to tip of cell 2A; extreme tip of cell 1A sometimes hyaline. Base of cell R_4 evenly rounded; r-m crossvein at basal two-fifths of cell $1M_2$, vein R_{2+3} arising opposite. Contact of cells $1M_2$ and Cu_1 slightly shorter or longer than width of base of cell Cu_1; cell 1A closed at margin or short petiolate; cell 2A not narrowed, wider than cell 1A postmedially; alula not reduced, posterior margin rounded. Stigmatic area pigmented. Calypter pigmented, fringe of hairs white or brown. Stem of halter brown, knob brown basally, yellow apically.

Legs with black scales. Middle and hind femora with one or two macrochaetae anterodorsally, or with only a few toward the apex; hind tibia with a single or double row of macrochaetae anterodorsally.

Sides of first abdominal tergum with black, white, or mixed pile; terga two through four, and sometimes five, six, and seven with black pile, setae and scales laterally. Posterior margin of first tergum with linear black scales; discs of terga two through four, and middle of five with linear black scales; remainder of terga with dense or sparse, linear or lanceolate, truncate, pos-

teriorly produced, white scales sometimes restricted to lateral margins and occasionally absent. Venter with black setae and linear scales.

MALE GENITALIA (Figure 64).—Gonocoxites very broad basally, dorsal margins tapering concavely to acute apices in lateral view; apices bluntly rounded in ventral view, mesal sulcus very narrow; setae evenly distributed as far as midway between medial fold and base. Basal segment of gonostylus elongate basally, slightly convex dorsally in lateral view; distal segment round basally in cross section, tapering to acute apex which is slightly bent upward and outward; ventral margin curved sharply upward before styliform part; setae present laterally and ventrally on basal part. Apex of epiphallus with a raised dorsal plate formed at a 45° angle, plate right angled basally, truncate apically in dorsal view; ventrolateral part curved inward below, extending out as far as middle of dorsal plate. Dorsal bands united mesally, without setae. Aedeagus narrow, tapering to junction with ventral bands before junction of dorsal bands.

FEMALE.—Similar to male. White scales on posterior abdominal terga restricted to lateral margin of fifth tergum or absent.

FEMALE GENITALIA (Figure 93).—Tenth tergum without spines. Ventral arm enlarged and bilobate apically. Dorsomedial angle of sclerite on each side of gonopore produced dorsointeriorly as a short, sharp, acuminate lobe; lateral arm tapering and curved upward apically; ventral arm broad basally, tapering to sharp apex which is slightly curved mesad. Each spermathecal duct about as long as bulb; first section very short; second section enlarged apically, about one-fourth longer than third section which is about half as long as bulb; bulb ovoid, narrowing basally to duct and somewhat constricted premedially.

DISTRIBUTION AND ECOLOGY.—*Anthrax analis* occurs throughout North America from northern Canada to Central America (Map 24). It is found in areas of sand dunes, along beaches, and in sandy or gravelly areas along rivers. It seems to be replaced in the forested areas of Mexico and Central America by *gideon,* although their distributions broadly overlap.

TYPES.—The type of *A. analis* Say apparently has been lost along with the remainder of Say's collection. Say's description, however, leaves little doubt as to the identity of the species. The type-locality is Georgia.

Painter and Painter (1962) found the type of *Anthrax georgicus* Macquart, a female, in the Ville de Lille, Museu d' Histoire naturelle. The head has been glued on, the antennae are nearly gone, and it has been in liquid at some time. The photograph of the wing is like that of a typical specimen of *A. analis.* The type-locality is Georgia.

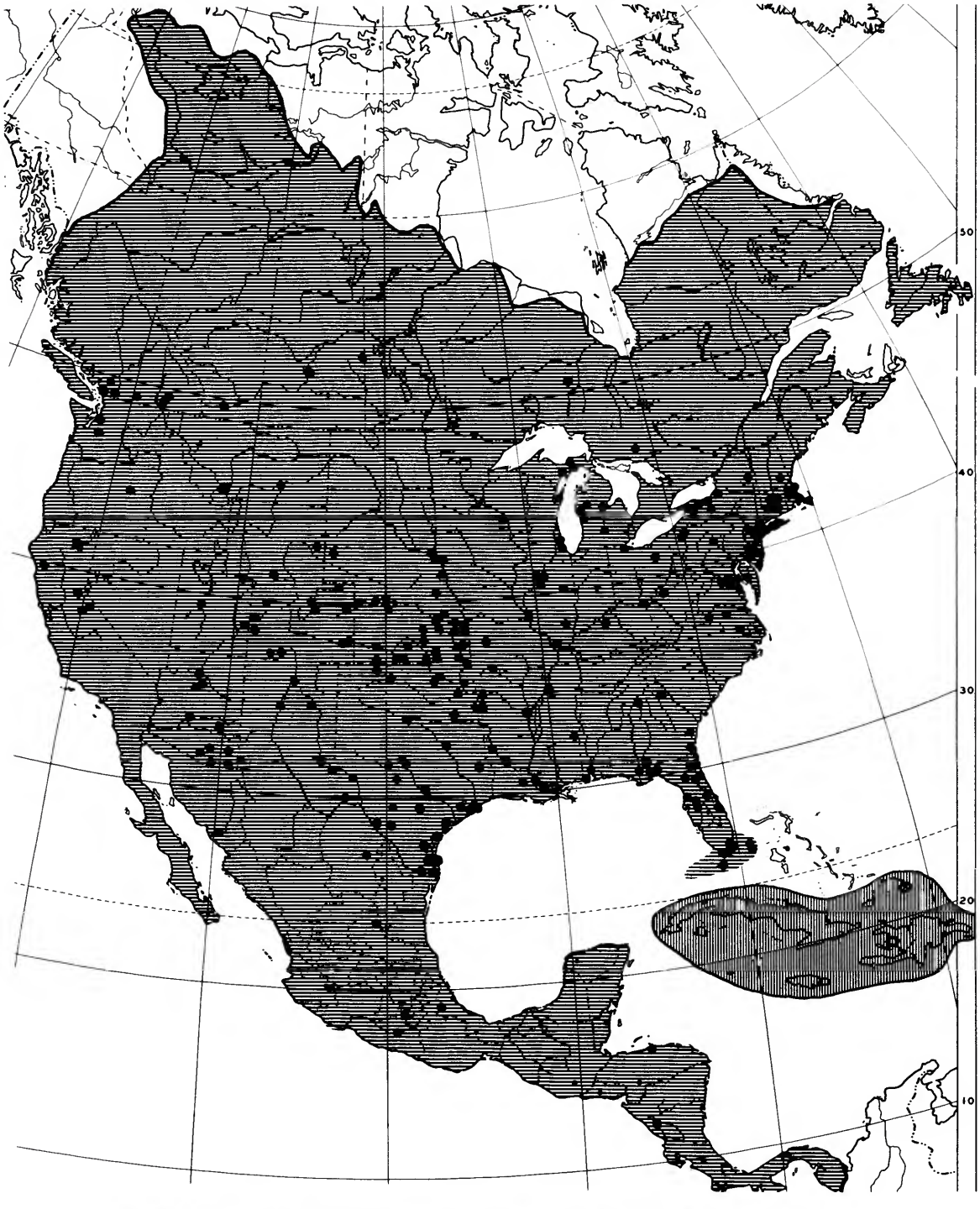
The type female of *Anthrax cedens* Walker is in the British Museum. According to Painter and Painter (1962), it "bears the green type label with '*A cedens* Walk.' on back, a second label '68–4,' a small yellow label with no writing, and 'U.S.A. pres. W. W. Saunders 1868–4.' " A photograph of the wing of the type shows it to be a rather heavily pigmented female like those discriminated below.

Painter and Painter (1962) stated that there were three female specimens in the Bigot collection in the British Museum under the name *Hemipenthes latelimbatus.* One specimen carried the pin label "*Hemipenthes latelimbatus* m, f, n. sp. Inédit. Avril 1889 J. Bigot Jun (?) Carolin." The best preserved specimen was selected as a lectotype. The photograph of the wing and description given by Painter and Painter clearly indicate that this species is synonymous with *A. analis,* f. *cedens* Walker.

The type male of *Spongostylum grossbecki* Johnson is deposited in the collection of the American Museum of Natural History and has been studied by the author. It lacks the head but is otherwise in excellent condition and is typical of males of the form *grossbecki* discussed later. Johnson (1913) erroneously referred the female of this form to *A. cephus* Fabricius. The type-locality is Lakeland, Florida.

The cotypes of *Spongostylum occidentalis* Johnson, from Denver, Colorado, and Seattle, Washington, are in the Museum of Comparative Zoology and have been seen by the author. Johnson (1913) named this species in a key to the species related to *analis* in North and South America but did not give a detailed description. He implied that one of the specimens was a male, although both are females. The specimen from Denver was in good condition except that one of the forelegs and the last segment of the antenna were missing. The specimen from Seattle was missing the head, one foreleg, and one hind leg, and was slightly rubbed. Both specimens fall within the range of variation of *analis* in the western United States.

BIOLOGY.—Shelford (1913) gave an excellent account of the life history and habits of *analis* which he reared from the burrows of "*Cicindela scutellaria* Say, var. *lecontei* Hald." (Coleoptera: Cicindellidae). Malloch (1915) described the larva and pupa, utilizing specimens collected by Shelford. *Anthrax analis* has



MAP 24.—Distribution of *Anthrax analis* (horizontal lines) and *A. funebris* (vertical lines).

been collected many times by the author in sandy areas where the females were seen ovipositing in holes in the sand. This species may parasitize bees and wasps nesting in such areas, in addition to tiger beetles.

DISCUSSION.—The extent of the pigment on the wings is variable in specimens from Florida and the coastal plain of the southeastern United States. It seems probable that a population was isolated in Florida in the past which evolved more extensively pigmented wings similar to those of the form *grossbecki* separated below. When this population came in contact with the mainland population again, hybridization took place so that now a gradient from normal to heavily pigmented forms occurs in that area. This fits the evolutionary scheme given by Hubbell (1954). The forms do not differ in other characters and they are all found sympatrically at the present time. Specimens that have the area of pigment slightly expanded also have been collected as far north as New York and as far west as Alabama. The two principal forms are distinguished below.

Anthrax analis f. *grossbecki* (Johnson)

Anthrax cephus.—Macquart, 1840, p. 337.—Osten Sacken, 1858, p. 39 [part] [not Fabricius, 1805].
Argyramoeba cephus.—Osten Sacken, 1878, p. 90 [part].—Coquillett, 1894, p. 95.—Johnson, 1895, p. 325 [part] [not Fabricius, 1805].
Spongostylum cephus.—Johnson, 1913, p. 56 [*Spogostylum*] [not Fabricius, 1805].
Spongostylum grossbecki Johnson, 1913, p. 56 [*Spogostylum*].

In this form, the wing of the female is completely black (Plate 3*c*) and the wing of the male has only a narrow hyaline area along the posteroapical margin (Plate 3*b*). It is restricted to Florida. When Johnson (1913) described *grossbecki* from the male, he erroneously referred the female to *cephus* Fabricius.

Anthrax analis f. *cedens* (Walker)

Anthrax cedens Walker, 1852, p. 190.—Osten Sacken, 1858, p. 39.—Osten Sacken, 1877, p. 238.—Kertész, 1909, p. 31.—Painter and Painter, 1962, p. 72.
Spongostylum cedens.—Johnson, 1913, p. 56 [*Spogostylum*].
Hemipenthes latelimbatus Bigot, 1892, p. 351.
Argyramoeba latelimbata.—Johnson, 1895, p. 325 [*latilimbata*].
Anthrax latelimbatus.—Aldrich, 1905, p. 232 [*latelimbata*].—Painter and Painter, 1962, p. 75.
Spongostylum latelimbatum.—Johnson, 1913, p. 55 [*Spogostylum latelimbata*].

In the female of this form, the pigment of the wing extends well beyond the base of cell R_4 and extends from cell R_5 into or across cell M_1, leaving the tip of cell $1M_2$ hyaline or subhyaline (Plate 3*e*). In the male, the pigment is less extensive, but extends broadly into the base of cell R_4 (Plate 3*d*). This form occurs from Florida north along the Atlantic coast to New York and west along the Gulf coast to Alabama.

Anthrax analis is very closely related to *gideon*. Most specimens of *gideon* have cell $1M_2$ less than half pigmented and have the pigment in cell R_5 extending as far as the base of cell M_1, but some specimens have been noted with a wing pattern similar to that of *analis* in that the pigment fills more than half of cell $1M_2$. In this case, the velvet black pruinosity on the dorsum of the thorax and abdomen of *gideon* may serve to separate the species.

Specimens with wings like those of *analis* and with other characters like those of *gideon* have been seen from several localities in Mexico, Central America, and northwestern South America. These may be only a form of *gideon* or they may be intermediates between *gideon* and *analis*. The first possibility seems most likely since the variant form has been collected as far south as Peru, far beyond the range of *analis*. It is possible that as in Florida the genetic potentiality for the intermediates originated from crosses between reunited populations. Extensive collecting and ecological observation may be necessary to determine the true relationship of the populations of *gideon* and *analis*.

Anthrax analis has been confused with *argentatus* from northwestern United States, but may be separated by the absence of patches of silver scales posterolaterally on abdominal terga two and three. The black-winged females of the form *grossbecki* have been confused with *cephus* and *koebelei*. They differ from the former in lacking hairs or setae on the anterior corner of the hypopleuron, and from the latter in having the styliform part of the third antennal segment at least 1.5 times as long as the base and in having the integument dull and heavily pruinose.

Anthrax funebris Macquart

Anthrax funebris Macquart, 1840, p. 344.—Osten Sacken, 1858, p. 40.—Aldrich, 1905, p. 231.—Kertész, 1909, p. 38.—Painter and Painter, 1962, p. 75.

FEMALE.—Integument generally black, pleura and legs sometimes reddish brown; integument grayish to brownish pruinose. Front with black setae and

lanceolate black scales. Face with black setae extending almost to antennae, a few white scales below. Occiput with short black setae and linear black scales; fringe of hairs on posterior margin black. First antennal segment about as long as apical width; second segment globular, about as wide as base of third segment in lateral view; base of third segment slightly compressed laterally, narrowing abruptly to styliform part which is one-half longer than base and about twice as long as style (Figure 115).

Discs of mesonotum and scutellum with fine black setae and linear scales, some longer, semierect scales and coarse setae laterally on mesonotum. Sternopleuron, mesopleuron, and anterior half of pteropleuron with fine black setae and linear scales, some black hairs and coarse setae dorsally on mesopleuron and pteropleuron. Pile on prosternum, propleuron, and anterior margin of mesonotum black, white hairs sometimes on propleuron and anterior margin of mesonotum; postalar tuft of pile black. Coxae with black setae and linear black scales. Hypopleuron and metapleuron bare.

Wing (Plate 4*k*) pigmented with dark brown, hyaline areas subapically in cell R_{2+3}, apically in cells R_4, Cu_1, and $1M_2$; a narrow hyaline area sometimes along posterior border connecting hyaline areas in cells R_4 and Cu_1, and sometimes connected to hyaline area in cell $1M_2$ across m crossvein. Base of cell R_4 edged by subhyaline. Base of vein R_4 evenly rounded; r–m crossvein located at basal two-fifths of cell $1M_2$; contact of cells $1M_2$ and Cu_1 equal to or slightly greater than base of cell Cu_1; cell 1A punctiform apically. Alula well developed, posterior margin rounded. Stigmatic area lightly pigmented, sometimes only partially. Calypter lightly pigmented; fringe of pile white. Halter dark brown, tip of knob yellow.

Femora and tibiae with lanceolate and cuneate black scales. Middle femur with one or two macrochaetae anteroventrally; hind femur with three or four macrochaetae anteroventrally; fore tibia with incomplete row of macrochaetae anterodorsally; hind tibia with single row of macrochaetae anterodorsally.

First abdominal tergum with white pile laterally; terga two through four with black pile and setae laterally; terga five through seven with black setae laterally. Posterior margin of first tergum and discs of posterior terga with fine, black setae and linear, black scales; a few white scales sometimes laterally on four and five. Abdominal sterna with fine, black setae and linear, black scales.

Female genitalia (Figure 92).—Tenth tergum with one or no spine on each side. Ventral arm of ninth tergum straight, slightly wider medially than at acute apex. Dorsomedial corner of sclerite on each side of gonopore produced dorsally as a short, sharply angled lobe; lateral arm narrow and curved upward apically; ventral arm narrow, twisted and slightly recurved mesally below. Each spermathecal duct about twice as long as bulb; first section very short; second section about as long as third, which is abruptly broadened apically to junction with bulb; bulb symmetrical, globoid, somewhat longer than maximum width and darker than duct.

Distribution.—Specimens of *A. funebris* have been studied from Haiti, Dominican Republic, and South Caicos Island in the Bahamas. It may occur also throughout the Greater Antilles and Bahamas, and possibly in the Lesser Antilles (Map 24).

New material examined.—Bahama Islands: *Turks and Caicos Islands*, ♀, South Caicos Island, II–11–1953 (E. B. Hayden and G. B. Rabb).

Dominican Republic: ♀, "St. Dom., 51.1."

Haiti: ♀, Bois Caradeux, VIII–10–1934 (E. M. Ducasse); ♀, Pivert, IV–1–1922, about 250 feet, "F. 4657" (C. H. Curran, Acc. 31144); ♀, St. Marc, III–30–IV–2–1922, "F. 4655."

Type.—Painter and Painter (1962) stated that the type of *Anthrax funebris* Macquart was in the Paris Museum. Only part of the thorax and most of one wing remained. It carried the museum labels "*A. funebris* Macqt. St. Domingue, 1607," and the pin labels "No. 907, *Anthrax funebris*" and "A. in St. Domingue." The distinctive wing pattern left little doubt as to the identity of the species.

Discussion.—*Anthrax funebris* is most closely related to *analis* and closely resembles specimens of the form *cedens*. In *funebris* the pigment on the wing extends from the tip of cell R_1 across the apex of cell R_{2+3} leaving a subapical hyaline area in cell R_{2+3}. In *analis*, if the pigment extends from the tip of cell R_1 into cell R_{2+3}, the latter cell is entirely pigmented.

All of the specimens of *funebris* examined are female. If *funebris* has the same kind of sexual dimorphism shown by the forms *cedens* and *grossbecki* of *analis*, the males will have less extensively pigmented wings.

Anthrax koebelei, new species

Male.—Body generally black or brown, legs other than coxae reddish brown; integument shining, sparsely

covered with gray and brown pruinosity, eye margins and lower half of occiput silver pruinose. Setae and scales on front black; setae on face mixed black and white extending to antennae. Dorsal part of occiput with black setae, ventral part with white setae and a few white scales; fringe of hairs on posterior margin black above, mixed black and white below. First antennal segment slightly longer than apical width, subcylindrical and angled toward meson; second segment large, globoid, slightly smaller than length of first segment and distinctly wider than diameter of base of third segment in mesal view; base of third segment flattened laterally, narrowing abruptly to styliform part about equal in length to base and style.

Mesonotum and scutellum with black setae and scales; a few white scales in front of wing. Pile and setae on mesopleuron, sternopleuron, and anterior part of pteropleuron white. Hypopleuron and metapleuron bare. Pile on prosternum, propleuron, and anterior margin of mesonotum white. Postalar tuft of pile white. Coxae with black and white setae and white scales.

Wing entirely translucent brown. Base of cell R_4 angular, with a short spur; base of cell R_{2+3} slightly basad of r-m crossvein; contact of cells $1M_2$ and Cu_1 about equal to base of cell Cu_1. Apex of cell 1A narrowly open. Cell 2A about as broad as cell 1A; alula well developed, posterior margin rounded. Stigmatic area in cell M reduced in size, not reaching apex of cell, not pigmented. Calypter pigmented light brown, fringe of hairs black. Base of halter dark red, knob dark red basally, yellowish at extreme apex above, mostly red below.

Scales on legs black, hind femur with two macrochaetae anteroventrally toward apex; middle femur without strong macrochaetae. Fore tibia with anterodorsal, posterodorsal, and posteroventral rows of macrochaetae; hind tibia with a single row of macrochaetae anterodorsally.

Pile and setae on sides of first abdominal tergum yellowish white; pile and setae on lateral margins of terga two through seven mostly white, with a few black setae. Discs of terga two through five with black and white setae and linear black scales, some white scales laterally on five; terga six and seven with long, narrowly lanceolate, silvery-white scales. Venter with sparse white setae.

Male genitalia (Figure 55).—Gonocoxites broad basally, dorsal margins curving gradually to ventral margins apically in lateral view; apices bluntly rounded in ventral view, and narrowly separated medially; setae sparse and evenly distributed beyond medial fold. Basal segment of gonostylus poorly developed, with an obtuse angle dorsally in lateral view, bluntly rounded apically and scarcely visible in ventral view. Distal segment of gonostylus bulbous basally with styliform apical part; apex of styliform part curved upward and outward to a sharp point; basal part with numerous fine setae. Apex of epiphallus with a broad dorsal shield, slightly emarginate apically and with three blunt teeth basally in dorsal view, angled downward at about 30° with apical part slightly depressed in lateral view; ventrolateral part formed behind and below dorsal shield, with nearly straight ventral margin about twice as long as slightly curved anterior margin in lateral view. Dorsal bands not uniting mesally, without setae; ventral bands uniting medially over aedeagus and below juxtaposition of dorsal bands. Aedeagus narrow basally, tapering gradually to junction with ventral bands; apex not visible in either dorsal or lateral view.

Female.—Similar to male. Pile, setae, and scales on body entirely black.

Variation.—The only other specimen of this species available, a male, is smilar in every respect to the holotype except that the fore femur has some white scales posteriorly and the posterior cells of the wing are subhyaline medially.

Distribution.—The three specimens available of this species are simply labeled "Arizona A. Koebele," and "2542."

Holotype.—♂, Arizona (A. Koebele) (2542) (CAS).

Allotype.—♀, same data as holotype (CAS).

Paratype.—♂, same data as holotype (NLM).

Biology.—All three specimens of *koebelei* were reared, but there are no data with the specimens.

Discussion.—*Anthrax koebelei* appears to have no close relatives in North and South America, but it may be confused with other species with entirely black wings. It may be distinguished readily from *cephus* and *aterrimus* by the absence of setae or hairs at the anterior corner of the hypopleuron. It differs from *analis* f. *grossbecki* in having the basal part of the third antennal segment about as long as the style rather than about half as long.

Anthrax inaquosum, new species

Female.—Body black, tibiae yellow; integument mostly gray and brown pruinose; margins of eyes, face,

and lower part of occiput silver pruinose. Front with black setae; face with white setae extending almost to antennae. Occiput with black setae on dorsal third, remainder with white setae, fringe of hairs on posterior margin black exteriorly and white interiorly above, white below. First antennal segment much shorter than apical width; second segment lenticular; base of third segment flattened laterally, distinctly broader than second segment in mesal view, narrowing abruptly to styliform part which is short, about as long as base and slightly shorter than style (Figure 100).

Discs of mesonotum and scutellum with linear yellow scales, margins with white scales. Sternopleuron, mesopleuron, and anterior half of pteropleuron with white setae and hairs and lanceolate white scales. Prosternum, propleuron, and anterior margin of mesonotum with white pile. Postalar tuft of pile white. Hypopleuron and metapleuron bare. Coxae with white bristles and lanceolate white scales.

Wing (Plate 3*k*) mostly hyaline, cells C and Sc subhyaline, faint light-yellow spots at bases of cells R_{2+3}, R_5, $1M_2$, Cu_1, R_1, and in cell R below base of R_1; base of wing lightly pigmented. Base of cell R_4 angled, without spur. R–m crossvein at basal two-sevenths of cell $1M_2$, vein R_{2+3} arising slightly basad. Contact of cells $1M_2$ and Cu_1 3.5 times longer than width of base of cell Cu_1. Anal cell open for distance equal to one-half width of r–m crossvein. Posterobasal part of wing not narrowed, cell 2A slightly wider than cell 1A postmedially; alula distinctly rounded posteriorly. Calypter not pigmented, fringe of hairs white. Halter yellow basally; knob light brown and yellow.

Femora with cuneate white scales, a few black scales apically on posterior pair. Fore and middle tibiae with light scales; hind tibia with white scales posteriorly and mixed black and white scales anteriorly. Middle femur without macrochaetae anteroventrally, hind femur with three macrochaetae anteroventrally toward apex; fore tibia with one bristle anterodorsally toward apex; hind tibia with incomplete row of macrochaetae anterodorsally.

First abdominal tergum with white pile laterally; lateral margins of posterior terga with scattered white hairs, black and white setae, and appressed white scales. Posterior margin of first tergum with lanceolate white scales; discs of posterior terga with linear black scales; yellow scales anteriorly on two and on seven; mixed yellow and white, lanceolate scales along posterior margins. Venter with lanceolate white scales and white setae.

Distribution.—Only one specimen of *inaquosum* is known. It was collected by the author along the Rio Mossoró near the railroad southwest of Mossoró, Rio Grande do Norte, Brazil. The area was sandy and apparently derived subterranean moisture from the river. The species probably occurs throughout the caatinga of northeastern Brazil.

Holotype.—♀, Mossoró, Rio Grande do Norte, Brazil, XII–5–1960 (N. Marston—2) (USNM).

Discussion.—*Anthrax inaquosum* apparently has no close relatives in the genus *Anthrax* in North and South America. It superficially resembles *Anthrax pauper* (Loew) from North America but may be distinguished readily by setae on the upper half of the face.

Anthrax trimaculatus Group

The *trimaculatus* group is a heterogeneous assemblage of species confined to South America, except for one specimen of *trimaculatus* Macquart collected at Barro Colorado Island, Canal Zone, Panama. Most species may be readily separated from those of the *cephus* group by absence of setae on the upper half of the face just below the antennae. The one species that has such setae, *plurinotus* (Bigot), has distinct spots at the bases of cells R_4 and M_1 (Plate 6*a*), while those spots are absent in species of the *cephus* group. The Neotropical species of the *oedipus* group differ by having short spurs at the medial angles of vein R_4 and the m crossvein of the wing, and by having numerous spots along the veins other than at the bases of cells. The species of the *tigrinus* group may be readily distinguished by the distinctive crossvein between the m crossvein and vein Cu_1 on the wing.

No good characters separate the *trimaculatus* and the *albofasciatus* groups, but each species of the former has some distinctive characters not found in the latter. Rather than risk confusion by a long statement of variable characters, the group key simply separates the two groups on a geographical basis. They appear to have been derived from a common early Pleistocenic ancestor and to have evolved differences in a variety of characters.

No comprehensive studies of the *trimaculatus* group have been reported previously, although Edwards (1930) discussed the Chilean species and Stuardo

Ortiz (1946) listed them in his catalog of the Chilean Diptera. Nine species are separated in this group; three, *baliopteros, latibasis,* and *caatingensis,* are described as new.

Although collections of most major museums in North and South America have been borrowed, only 96 specimens of the *trimaculatus* group have been obtained, of which 79 are *trimaculatus*. Thus, all notes regarding distributions and geographic variation are tentative. With further collecting, new species probably will be discovered in areas such as Bolivia, Argentina, and Chile.

Group Description

Body generally black, femora, tibiae, proximal tarsal segments and margins of abdominal sterna and posterior terga often yellow or red. Pruinosity mostly gray or brown, sometimes blue green; eye margins and front with silver pruinosity. Head globoid; eyes separated by 1.0 to 3.0 times width of ocellar tubercle at vertex; antennal sockets separated mesally by about 0.5 their width and about 0.5 to 1.0 of their width from eye margins. Face and lower part of front produced slightly above eye margins; oral margin obtusely angular. Front covered with fine setae and lanceolate scales; lower half and lateral margins of face with setae, setae sometimes present on upper half extending almost to antennae. Occiput with short, semirecumbent setae and sparse, small, lanceolate scales; fringe of pile on posterior margin white to black, usually with lighter tips, some white hairs often present behind vertex. First antennal segment cylindrical or enlarged mesad apically, varying in length from 0.5 to 1.5 times apical width. Second segment globular or greatly flattened apically. Third segment rounded basally, more or less flattened laterally, tapering abruptly or gradually to styliform part, which varies from 0.5 to 1.5 the length of the base; style 0.2 to 1.5 times the length of the styliform part.

Disc of mesonotum with fine black setae and linear, curly scales; scales mixed yellow and white, or forming complex pattern of spots and stripes of white, gold and black scales; lateral and posterior margins with curly white scales. Scutellum with sparse, black setae and linear or lanceolate scales that are mixed white and yellow, or more commonly, black in submedial spots, white laterally or anteriorly and at apex, and yellow or gold elsewhere. Macrochaetae black or, rarely, more or less red. Sternopleuron, mesopleuron, and anterior part of pteropleuron with white setae and scales, some black setae and yellow or white pile often present dorsally on mesopleuron and pteropleuron. Prosternum, propleuron, and anterior margin of mesonotum with white or yellow pile, some black setae on latter. Postalar tuft of pile white or yellow. Hypopleuron and posterior part of pteropleuron bare. Metapleuron bare or with white scales in patches dorsally and ventrally or directly behind spiracle. Coxae with black, gold, white or mixed, setae and white scales.

Wing (Plate 6*a–i*) highly variable, largely hyaline or with discrete or coalesced spots at bases of some or all of major cells; rarely with spots at apices of veins M_2, Cu_1, and Cu_2; postmedial spot often present in cell R_1. Sectoral crossvein present or absent; when absent, spur at base of cell R_4 0.3 to 2.0 times width of base of cell; spur at base of cell R_{2+3} absent or as much as 2.0 times longer than width of base of cell. Cell 2A well developed with rounded margin, or greatly narrowed with straight margin. Calypter unpigmented, fringe of hairs white. Stem of halter light brown, knob light or dark brown basally, yellow or white apically.

Scales on femora mostly white, some black, or rarely yellow, scales present anterodorsally toward apices, especially on fore and middle pairs. Scales on tibiae black anteriorly and white posteriorly, or sometimes entirely white. Fore femur with incomplete row of macrochaetae anterodorsally; middle femur with anteroventral row (sometimes incomplete); hind femur with anteroventral and sometimes more or less complete posteroventral rows of macrochaetae; scattered bristles sometimes present dorsally toward apex. Tibiae with rows of macrochaetae at all four angles, except anteroventral angle of fore pair.

Discs of abdominal terga usually with scattered black setae and abundant linear or lanceolate scales, rarely with abundant, long black setae and curly, hairlike scales. Black scales present in most species in mesally interrupted bands medially on two and anteriorly on posterior terga, sometimes absent on five, six, and seven; white scales along posterior margins and sometimes on meson; remainder of scales gold or yellow; black scales in continuous bands in *squalidus*. Pile on lateral margins of first tergum white or yellow; scales on posterior margin white, sometimes dense and curly. Lateral margins of terga two, three, and rarely

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four with black setae and with black, hairlike to obovate, short or long scales anteriorly and white or yellow scales posteriorly, black scales rarely absent; posterior terga with black setae and white or yellow scales. Venter with sparse, yellow, white, or black setae and linear to obovate white scales.

Gonocoxite of male genitalia (figures 128–137) broad basally, tapering or curving to sharp to broadly rounded apex; apex rounded or flattened, usually with coarse or fine, dense or sparse setae; medial sulcus broad or narrow, with sharp or gradually curved margins. Basal segment of gonostylus simple, platelike, with or without apical setae. Distal segment of gonostylus highly variable, often triangular basally and tapering upward and outward to sharp apex, with various teeth, spines or ridges, sometimes dactylate, ovate and flattened, or with dactylate lateral lobe. Dorsal part of apex of epiphallus highly variable, often with dorsocentral flat plate or spine, deeply emarginate to sharply rounded apically in dorsal view; ventrolateral part broad or narrow, acute or truncate distally; dorsomesal Dorsal band usually with few setae in *minimaculatus*, with preapical, apically projecting lobe in *squalidus*. Base of aedeagus bulbous and narrowing abruptly or narrow and gradually tapering to junction with ventral bands before or after junction of dorsal bands. Lateral apodemes of aedeagus open dorsoapically or apically; basal apodeme large, semicircular or circular.

Ninth tergum of female genitalia (figures 122–126) simple, apices of ventral arms acute or slightly expanded with short, curved apical lobe. Tenth tergum with six to ten spines on each side. Sclerite on each side of gonopore hatchet shaped or club shaped; lateral arm broad or narrow, acute or truncate distally; dorsomesal angle sharp, obtuse, rounded or produced as broadly rounded lobe; ventral arm narrow, tapering or parallel sided, and curving slightly mesad. First section of each spermathecal tube short, smooth; second section slightly shorter or slightly longer than bulb, granularly pubescent; third section short, tapering to bulb; bulb oblanceolate or obovate, of equal size.

Taxonomic Characters

The species of the *trimaculatus* group have undergone a great amount of differentiation so that there are discrete differences between most taxa. The wings of the *trimaculatus* group (Plate 6*a–i*) are highly variable between species, ranging from nearly hyaline in *squalidus* to heavily marked with pigment on the anterobasal portion and at the bases of the posteroapical cells in *baliopteros* and *plurinotus*. All species except *plurinotus, squalidus,* and *mystaceus* have a distinctive quadrate spot in cell R_1 below the tip of vein Sc. Significant variation in the wing pattern has been noted only in *trimaculatus* and *bellulus,* but in both it is simply an expansion or contraction of the area of pigment, the extent of which may depend on environmental factors as much as on inherited differences. Specimens of the same species of *Anthrax* generally have been noted to be darker from wet areas than those from dry areas.

Two species in the *trimaculatus* group, *plurinotus* and *bellulus,* have the posterobasal area of the wing greatly reduced, similar to the species related to *argyropygus* in the *cephus* group. The base of cell 2A is almost punctiform and the cell is distinctly narrower than cell 1A; the alula is reduced to a narrow strip of membrane with a straight posterior margin. Again, no species of the *albofasciatus* group show that character. A complete sectoral crossvein is present in *bellulus* and *latibasis.* It often is a somewhat plastic character in other groups, so specimens may lack the crossvein in one or both wings. The sectoral crossvein that Macquart (1840) noted on the wing of *mystaceus* and that he used as a diagnostic character for the genus *Spongostylum* is clearly spurious, judging from the figure of the wing. One specimen of *mystaceus* examined showed the crossvein, and one specimen had a short spur extending anteriorly toward vein R_{2+3} (Plate 6*i*) in the same position as the crossvein in Macquart's figure.

The vesture of the body is similar in all species of the group except *squalidus,* which has distinctive long black setae on the abdominal dorsum and black and white pile on the sides of the abdomen. Patterns of scales and hairs on the remaining species are essentially similar, although the extent of the colors varies somewhat. However, *mystaceus* has a distinctive patch of white scales on the metapleuron directly behind the spiracle, and *latibasis, bellulus,* and *minimaculatus* have dorsal and ventral patches of white scales on the metapleuron. The alternating tufts of erect, white or yellow and black scales on the sides of abdominal terga two, three, and four are peculiar to *trimaculatus, latibasis, minimaculatus,* and *bellulus.*

The male genitalia vary widely interspecifically in the *trimaculatus* group and are excellent taxonomic characters, as illustrated in figures 128–137. Forms of

the apex of the gonocoxite, distal segment of the gonostylus, and the apex of the epiphallus, in particular, are distinctive in each species. Significant variation is found in the structure of the genitalia of *trimaculatus*, the only species represented by enough specimens to allow a study. The limits, however, are not so wide as to lead to confusion with other species. The female genitalia also vary between species, although less strikingly than in males. Here, the shape of the sclerite on each side of the gonopore is most distinctive. The various structures of the male and female genitalia are named and discussed under the *cephus* group. The form of the male and female genitalia is not emphasized in keys and diagnoses because there are excellent external characters for separating the species. The externally visible parts of the male genitalia, however, provide an excellent supplementary character to check determinations.

Key to the Neotropical Species of the *Anthrax trimaculatus* Group

1. Wing with a distinct spot postmedially in cell R_1 (Plate 6*b–g*) 2
   Wing hyaline postmedially in cell R_1 (Plate 6*a,h–i*) 8

2(1). Bases of cells M_1 and $2M_2$ of wing pigmented (Plate 6*b,e–g*) 3
   Bases of cells M_1 and $2M_2$ of wing hyaline (Plate 6*c–d*) 6

3(2). Vein Cu_2 of wing without spot apically; spots at bases of cells R_4 and M_1 not expanded along veins (Plate 6*e–g*). Metapleuron with at least some scales above and behind spiracle. Western South America 4
   Vein Cu_2 and often vein Cu_1 of wing with spots apically; pigment at bases of cells R_4 and M_1 expanded along veins (Plate 6*b*). Metapleuron bare. Southern Brazil and Uruguay. ..... ***baliopteros***, new species

4(3). Metapleuron with patch of white scales ventrally behind spiracle. Wing usually with sectoral crossvein (Plate 6*f–g*) 5
   Metapleuron bare ventrally. Basal angle of vein R_4 of wing with long spur, but not joined to vein R_{2+3} to form sectoral crossvein (Plate 6*e*). Western Argentina ..... ***minimaculatus*** Oldroyd

5(4). Cell 2A of wing greatly narrowed on basal half, distinctly narrower than cell 1A; alula greatly narrowed, posterior margin straight (Plate 6*g*). Chile ..... ***bellulus*** Philippi
   Cell 2A of wing not narrowed on basal half, wider than cell 1A; alula broad, posterior margin convex (Plate 6*f*). Peru ..... ***latibasis***, new species

6(2). Basal half of cell 2A of wing broader than cell 1A; alula well developed with convex posterior margin (Plate 6*c–d*). Eastern South America to Panama 7
   Cell 2A of wing greatly narrowed on basal half, narrower than cell 1A; alula greatly reduced, posterior margin straight (Plate 6*g*). Chile ..... ***bellulus*** Philippi

7(6). Abdominal terga two, three, and four with tufts of erect black scales laterally; discs with medially interrupted bands of black scales. Southern Brazil and northern Argentina to Panama (Map 25) ..... ***trimaculatus*** Macquart
   Abdomen without black scales, with white setae and few white scales laterally. Northeast Brazil ..... ***caatingensis***, new species

8(1). Bases of cells in outer part of wing pigmented (Plate 6*a,i*). Abdomen without long, black and white pile on lateral margins 9
   Wing nearly hyaline (Plate 6*h*). Abdomen with long, black and white pile on sides. Chile. ..... ***squalidus*** Philippi

9(8). Metapleuron bare. Setae on face extending nearly to antennae. Chile and western Argentina ..... ***plurinotus*** (Bigot)
   Metapleuron with dense patch of scales behind spiracle. Setae on face restricted to lower half. Chile ..... ***mystaceus*** (Macquart)

Anthrax trimaculatus Macquart

Anthrax trimaculatus Macquart, 1848, p. 194 [*trimaculata*].—Kertész 1909, p. 56.—Marston, 1964, p. 104.
Argyramoeba imitans Schiner, 1868, p. 122.—Van der Wulp, 1882, p. 86.—Kertész, 1909, p. 64.
Anthrax imitans.—Painter, 1933, p. 5 [*initans*].

MALE.—Body generally black, tibiae, margins of apical abdominal segments, and sometimes femora and margins of proximal abdominal segments red orange. First antennal segment inverted conical, about 1.5 times apical width; second segment buttonlike, about one-half wider than long; bulbous basal part of third segment slightly narrower than second segment, attenuating to styliform part, which is about as long as base and twice as long as style. Front with black setae and scattered, linear, yellow scales; face with black and white setae along oral and lateral margins, bare on upper half below antennae. Occiput with black setae and linear gold scales on upper third, with white setae and scales below; fringe of pile on posterior margin black or yellow on upper third, white below and behind vertex.

Disc of mesonotum with fine black setae and linear scales, white in posteriorly bifurcate medial stripe and transversely in front of bases of wings, light yellow to gold elsewhere, submedial spots of black scales present posteriorly on specimens with gold scales; lateral and posterior margins with long, linear, semirecumbent white or white and yellow scales and black setae and macrochaetae. Scutellum with black setae and linear scales varying from yellow on disc and white on margins to black on disc and gold on margins. Sternopleuron, mesopleuron, and anterior part of pteropleuron with fine white setae and linear white scales, some black and gold macrochaetae present dorsally on last two. Propleuron, prosternum, and anterior margin of mesonotum with white or yellowish-white pile, some black setae on latter. Postalar tuft of pile white or yellowish white. Metapleuron bare or with few linear white scales just above coxa. Coxae with black, gold and white bristles and linear and lanceolate white scales.

Wing (Plate 6*c*) hyaline with light or dark brown spots at bases of cells R_{2+3}, R_5, $1M_2$, Cu_1, postmedially in cell R_1, and below base of cell R_1 in cell R; spots varying from small and distinct to large and confluent; base of cell $2M_2$ with very small spot in darker specimens. Bases of cells R_{2+3} and R_4 with basal spurs about as long as basal sections of veins. R–m crossvein at basal two-fifths of cell $1M_2$, vein R_{2+3} arising opposite; contact of cells $1M_2$ and Cu_1 about 1.5 times longer than width of base of cell Cu_1. Cell 2A 1.0 to 1.5 times as wide as cell 1A; alula well developed with posterior margin distinctly convex. Calypter unpigmented, fringe of hair white. Stem of halter light to dark brown, knob dark brown basally, yellow apically.

Anterior sides of femora with black and dark brown scales apically and yellow to gold scales basally, posterior sides with white scales. Fore and middle tibiae with black scales anteroventrally and white scales elsewhere; hind tibiae with mixed black, white, and yellow scales. Middle femur with anteroventral row of macrochaetae; hind femur with anteroventral and posteroventral rows.

First abdominal tergum with white or yellowish-white pile laterally, some black hairs on darker specimens; posterior margin with long, curly, lanceolate white scales. Lateral margins of terga with long, erect, black pile, lanceolate scales and setae medially on two, and anteriorly on three, four, and sometimes five; remainder of lateral margins with black and white setae, and lanceolate and ovate, white, yellow, and sometimes gold scales. Discs of terga two through seven with fine black setae and linear scales, black in medially interrupted transverse bands or spots of varying extent, white along meson, and medially and laterally along posterior margins of all but three and four, yellowish white to reddish brown over remainder. Venter with white or yellowish-white setae and sparse white scales.

MALE GENITALIA (Figure 132).—Gonocoxites broad basally, bilobed apically; apical lobes membranous laterally, separated mesally by deep sulcus; dense, fine hair on lobes and mesally before bases of lobes. Basal segment of gonostylus simple, slightly convex dorsally, with fine hairs apically. Distal segment of gonostylus projecting apicolaterally, with flat basal section from which the apical section curves dorsally and laterally; apex of dorsal section acute or flat and rounded, dorsal margin flat, with ridges, or with preapical tooth; preapical ventral tooth on one specimen. Dorsal part of apex of epiphallus flat, acute basally in lateral view, sharply angled basally in dorsal view; apex broadly rounded in dorsal view, right angled dorsally and broadly rounded ventrally in lateral view. Ventrolateral part of apex of epiphallus extending downward and backward from dorsal part, with sharp ridge curving upward and apically from point below proximal end of dorsal part. Dorsal band unmodified. Base of aedeagus tubular, tapering gradually to junction with ventral bands. Epandrium simple with irregular margins.

Cerci narrow, with few setae, with sharp ventral lobe.

FEMALE.—Similar to male.

FEMALE GENITALIA (Figure 125).—Tenth tergum with ten spines on each side. Ventral arm of ninth tergum broad, S-shaped distally, with small, dactylate ventral projection. Dorsal part of sclerite on each side of gonopore produced dorsolaterally as a broad, flat plate with blunt dorsomedial angle, sharp dorsal angle, and broadly rounded ventrolateral angle; ventral arm narrow and curved mesad at tip. Each duct of spermathecae slightly longer than bulb; first section short, clear; second section about as long as bulb, covered with granular pubescence; third section very short; bulb elongate oval, tapering basally to junction with duct.

DISTRIBUTION AND ECOLOGY.—*Anthrax trimaculatus* has been collected east of the Andes Mountains from Uruguay and northern Argentina to Panama (Map 25). It occurs in a wide variety of habitats, from the caatinga of northeastern Brazil to the grasslands of southern Brazil and the tropical rain forest of Panama. Specimens were collected by the author throughout much of eastern Brazil, usually along paths or near soil or clay banks where bees were nesting.

BIOLOGY.—One reared specimen of this species has been studied. It was reared from the nest of a species of *Diadasia* (Hymenoptera: Apoidae) by Pe. Jesus S. Moure. The pupa was described previously (Marston, 1964).

TYPES.—The type male of *Anthrax trimaculatus* Macquart is in the Bigot collection in the British Museum. According to notes by R. H. and E. M. Painter, the right wing and third antennal segments are missing, the head is glued on, and some fungus is present. It carries the label "*Anthrax trimaculata* nov. sp. ♂ Brasil Macq. D. Ex. nom. +." A photograph and redescription of the type made by the Painters agrees well with specimens from northeastern Brazil. The type-locality given by Macquart is "Brasil."

The type male of *Argyramoeba imitans* Schiner is in the Vienna Museum. R. H. and E. M. Painter found it "in good condition except that it is greasy." It is labeled "Lindig 1864 Venezuela" and "imitans Schin. Alte Sammlung." A specimen from Corazal, Canal Zone, Panama, agrees with the redescription made by the Painters. They also labeled a specimen from Paraiba, Brazil, as a homotype.

DISCUSSION.—Edwards (1930) recorded *imitans* from Chile, but he was undoubtedly referring to a light-colored specimen of *bellulus* Philippi.

Anthrax trimaculatus is a highly variable species. Specimens from forested areas in southern Brazil have the spots on the wings largely or entirely coalesced; whereas, at the other extreme, specimens from the desert area of northeastern Brazil may have small and distinct spots. The male genitalia also vary considerably especially the distal segment of the gonostylus, which may have the dorsoapical projection sharply tapered or flattened and broadly rounded distally, and with or without dorsal ridges or a dorsal spine. A complete range of variation has been noted in a long series of specimens from Itú, São Paulo, Brazil. As variation is wide within habitats and intergradations occur between habitats, all variations noted are regarded here as the same species.

One specimen from Tucumán, Argentina, has a short preapical tooth ventrally on the dorsoapical part of the distal segment of the gonostylus, and has the dorsal part of the apex of the epiphallus distinctly shorter than in other males of *trimaculatus* examined. However, because the specimen's external characters fall within the range of variation of specimens from eastern Brazil, and since there is considerable variation in the structure of the male genitalia in that area, the specimen from Tucumán is regarded simply as a variant.

Anthrax trimaculatus differs from *latibasis* and most specimens of *bellulus* in lacking spots at the bases of cell R_4 and M_1 and in lacking a sectoral crossvein. Specimens of *bellulus* with light-colored wings may be distinguished readily by the reduced anal margin of the wing. *Anthrax trimaculatus* differs from other species with a postmedial spot in cell R_1 by having long, erect black scales and pile on the sides of abdominal terga two, three, and four.

Anthrax latibasis, new species

MALE.—Body mostly black, brownish and grayish pruinose; legs except metatarsi and dorsoapical parts of femora, margins of thoracic pleura, lateral and posterior margins of abdominal terga, posterior margins of abdominal sterna, and genitalia orange. Front with black setae and lanceolate white scales. Face with black setae laterally and along epistomal margin, upper half bare below antennae; some yellowish-white hairs below. Occiput with fine, short, black setae and lanceolate scales, yellow along eye margins on upper third, white elsewhere; fringe of pile on posterior margin white below and behind vertex, black above. First an-

MAP 25.—Distribution of *Anthrax trimaculatus*.

tennal segment inverted conical, about as long as apical width; second segment buttonlike, narrower than apex of first segment and slightly wider than base of third; third segment bulbous basally, tapering abruptly to styliform part, which is about as long as base and about twice as long as style; setae on basal segments black.

Disc of mesonotum with fine black setae and linear black, gold, and white scales forming complex pattern of longitudinal bands and spots. Lateral and posterior margins with coarse black setae and semierect, curly, linear and lanceolate white scales. Anterior margins and apical spot on scutellum with linear white scales; disc with patches of linear black scales on each side; remainder of disc and posterior margin with gold scales. Mesopleuron, sternopleuron, and anterior part of pteropleuron with fine, yellowish-white setae and erect, oblanceolate, curly white scales; some coarse gold setae and bristles above on mesopleuron and pteropleuron. Prosternum, propleuron, and anterior margin of mesonotum with white pile, some black setae present on latter. Postalar tuft of pile white. Metapleuron behind spiracle with small tuft of lanceolate white scales above and larger patch of linear white scales below. Coxae with black setae and linear and lanceolate white scales.

Wing (Pate 6*f*) largely hyaline, cells C and Sc and extreme base subhyaline; brown spots at bases of cells R_4, M_1, $2M_2$, R_{2+3}, and R_5, in cell R_1 above base of sectoral crossvein, running from base of cell R_1 to base of cell Cu_1, and from base of cell R to base of cell 2A. Base of cell R_4 connected to vein R_{2+3} by an evenly curved crossvein without spurs. R–m crossvein located halfway from base to apex of cell $1M_2$; vein R_{2+3} arising opposite, with basal spur slightly longer than r–m crossvein. Contact of cells $1M_2$ and Cu_1 about 1.5 times longer than base of cell Cu_1. Cell 2A not reduced, slightly wider than cell 1A; alula broad, posterior margin distinctly convex. Calypter subhyaline, fringe of hairs black. Stem of halter light brown, with lanceolate white scales at base; knob dark brown basally, light yellow at apex.

Femora and tibiae with ovate-truncate, white scales except for some yellow and black scales anterodorsally at apices of femora. Middle femur with complete row of macrochaetae anteroventrally; posterior femur with complete anteroventral and posteroventral rows of macrochaetae and few scattered dorsally at apex.

Lateral margins of first abdominal tergum with white pile; posterior margin with long, curly, lanceolate white scales. Lateral margins of terga two, three, and four with long, erect, lanceolate-truncate, dark brown and white scales anteriorly, and white scales along posterior margins; lateral margins of terga five, six, and seven with shorter, ovate-truncate white scales posteriorly. Discs of terga two and three with linear scales, white anteriorly on first and in medial posterior spots on both, black in transverse, medially interrupted bands on posterior margins, mixed yellow and gold elsewhere. Fourth tergum with submedial patches of linear black scales separated by mixed yellow and white scales, and mixed yellow and white, lanceolate-truncate scales laterally. Fifth, sixth, and seventh terga with lanceolate-truncate, yellow scales anteriorly and lanceolate-truncate white scales posteriorly, small patch of linear black scales present medially on five. Entire dorsum with scattered black setae. Venter with fine yellow setae and scattered, short, lanceolate- and ovate-truncate white scales.

Male genitalia (Figure 128).—Gonocoxites broad basally, tapering in both lateral and ventral view to sharp apices; medial sulcus narrow and deep, widened toward base; lateral margin unsclerotized medially; fine setae scattered from base to apex. Basal segment of gonostylus platelike and rounded dorsally in lateral view, not extending past base of distal segment, with few fine setae apically. Distal segment of gonostylus with rectangular, proximally emarginate basal part curving mesad dorsally, from which a dactylate, apically broadened and truncate lobe extends distally. Dorsal part of apex of epiphallus with short, narrow, dorsomesal part and apically rounded, ventrobasally acute, larger lobes extending downward and forward. Ventrolateral part of apex of epiphallus very narrow apically, but recurving ventrally to form broad, rectangular preapical plate. Dorsal bands simple, narrow after junction above aedeagus. Basal part of aedeagus narrow, tapering gradually to tip with slight enlargement below junction of dorsal bands. Epandrium simple, with coarse bristles. Cerci oblong, tapering from dorsal margin near base to rounded apex; dorsal two-thirds velvet black, bottom third orange; with dense, minute setae giving velvety appearance.

Female.—Similar to male. Wing pigment slightly more extensive, cell M largely pigmented. Fore and middle tibiae with black scales anteriorly. Dorsum of abdomen with black and white scales more extensive and gold scales less extensive.

Female genitalia (Figure 124).—Tenth tergum with six spines on each side. Ventral arm of ninth tergum parallel sided and tapering slightly to acute apex.

Dorsomedial angle of sclerite on each side of gonopore extending mesally as broad, apically rounded lobe about equal in length to lateral arm, which is broad and shallowly emarginate apically; ventral arm narrow, parallel sided and slightly curved mesad. Each duct of spermathecae about twice as long as bulb; first section short, unpigmented; second section about 1.5 times longer than bulb, pigmented and covered with granular pubescence; third section short; bulb ovoid, with acutely rounded tip.

VARIATION.—The remaining specimens of this species seen by the author do not vary beyond limits of the holotype and allotype.

DISTRIBUTION.—The few specimens of *latibasis* available indicate that it occurs in the desert area along the coast of Peru and perhaps into northern Chile. The female specimens from Matucana were collected along a railroad track in an area with only a few cacti and tufts of grass among rocks.

HOLOTYPE.— ♂, Matucana, Lima, Peru, V-21-1920 (Cornell Univ. Exped. Lot 569) (AMNH).

ALLOTYPE.— ♀, Matucana, Lima, Peru, X-31-1964, 8000 feet (R. H. Painter) (RHP).

PARATYPES.—Peru: *Arequipa,* ♂, ♀, Arequipa, 1922 (Dt. E. P. Reed) BM 1931-360 (BM). *Lima,* ♀, Chosica, III-23-1964 (Peter Hocking) (caught in short grass by path) (RHP); 2 ♀, Matucana, X-31-1964, 8000 feet (R. H. Painter) (RHP, NLM). "Canta," VI-26-1955, 2800 m (Weyrauch) (WKW).

DISCUSSION.—Both *latibasis* and *bellulus* have the spur at the base of cell R_4 of the wing connected to vein R_{2+3} to form a stable sectoral crossvein. In this case, the crossvein is evenly curved and has no short spurs extending from it. In some other species some specimens may have a spurious crossvein, in which case it is angled and bears short spurs; there may also be differences between the two wings and other evidence of abnormal venation such as short spurs and crossveins. Judging from the illustration given by Macquart, the type of *Spongostylum mystaceum* has such an abnormal crossvein and is probably a species that normally has only two submarginal cells.

Anthrax latibasis is most closely related to *bellulus* Philippi. The two species are quite similar in external appearance, but may be readily distinguished by the reduced anal margin of the wing of the latter. The male genitalia also are quite different as shown in the illustrations. *Anthrax latibasis* and *bellulus* differ from other species with a postmedial spot in cell R_1 by the presence of a stable sectoral crossvein and patches of white scales on the metapleuron behind the spiracle.

Anthrax bellulus Philippi

Anthrax bellulus Philippi, 1865, p. 675 [*bellula*].—Kertész, 1909, p. 30.—Oldroyd, 1938, p. 84.—Stuardo Ortiz, 1946, p. 96 [*bellula*].

Spongostylum inappendiculatum Bigot, 1892, p. 351 [*Spogostylum*].—Kertész, 1909, p. 58.

Anthrax inappendiculatus.—Edwards, 1930, p. 172.—Stuardo Ortiz, 1946, p. 93.

Anthrax imitans.—Edwards, 1930, p. 172 [not Schiner, 1868, misidentification].

MALE.—Body mostly black, legs orange or with dorsoapical parts of femora dark red; apices of sterna broadly orange, of terga narrowly orange. Front with black setae and scattered, lanceolate white scales. Lower half and lateral margins of face with mixed black and yellow setae; upper half of face bare below antennae. Occiput with fine, scattered setae, black on upper two-thirds, white below; scales linear, gold along eye margins on upper third, white elsewhere; fringe of pile on posterior margin black behind gold scales, white elsewhere. First antennal segment about as long as apical width; base of third segment slightly narrower than second segment, bulbous, constricting abruptly to a styliform part which is about as long as base and about twice as long as style.

Disc of mesonotum with fine black setae; linear scales white in medial stripe which divides a round patch of black scales on posterior half, black and orange laterally on anterior half; lateral and posterior margins with woolly, semierect, linear white scales, and black setae and macrochaetae. Scutellum with fine black setae and linear scales, gold along margins, black on disc, few white scales anterolaterally and posteromedially. Sternopleuron, mesopleuron, and anterior part of pteropleuron with white pile and linear scales, gold and black macrochaetae dorsally on last two. Prosternum, propleuron, and anterior margin of mesonotum with yellow and white pile, some black setae on latter; postalar tuft of pile yellow. Metapleuron with patches of linear scales dorsally and ventrally behind spiracle. Coxae with black and yellow setae and linear and lanceolate white scales.

Wing (Plate 6*g*) hyaline with light brown spots at bases of cells R_{2+3} and R_5, R_4, M_1, $2M_2$, in cell R_1 above base of sectoral crossvein, running from base of cell R_1 to base of cell Cu_1, and at bases of cells R, M, and 1A; spots occasionally reduced or absent at bases of cells R_4, M_1, and $2M_2$; base of wing and cells

C and Sc light brown. Sectoral crossvein usually present, without angles and spurs. Basal angle of vein R_{2+3} with long spur. Contact of cells $1M_2$ and Cu_1 about three times longer than width of base of cell Cu_1. R–m crossvein about halfway to apex of cell $1M_2$; vein R_{2+3} arising basad about length of r–m crossvein. Cell 2A greatly narrowed basally; alula reduced, posterior margin straight. Calypter subhyaline, fringe of hairs brown above, white below. Stem of halter brown, darker above, with few white scales at base; knob dark brown, tip yellow.

Scales on femora mostly white, some black ones anterodorsally on apical halves, especially on fore and middle pairs. Scales on tibiae white. Middle femur with row of macrochaetae anteroventrally; hind femur with anteroventral row of macrochaetae and some scattered anterodorsally toward apex.

First abdominal tergum with white pile laterally and linear, curly white scales along posterior margin. Lateral margins of terga two through four with scattered black setae and long, erect, lanceolate-truncate scales, mostly black anteriorly on segments, yellowish-white posteriorly; lateral margins of terga five, six, and seven with ovate-truncate, yellowish-white and white scales along posterior margins. Discs of terga two through seven with scattered black setae and linear scales, black in submedial patches posteriorly on two and anteriorly on three and four, white anteriorly on two, longitudinally along meson, and posterolaterally, especially on posterior terga, scales mostly gold elsewhere. Venter with light-yellow setae and lanceolate white scales.

Male genitalia (Figure 133).—Gonocoxites broad in ventral view, narrow apically in lateral view; apices gradually rounded to rounded mesal angles in ventral view; mesal sulcus narrow; lateral margins unsclerotized apically; setae scattered over apical four-fifths. Basal segment of gonostylus simple, slightly convex dorsally in lateral view, with few fine setae apically. Distal segment of gonostylus projecting distally, a flat plate curving upward and outward with acute distal and lateral angles apically. Dorsal part of apex of epiphallus with raised transversely rounded mesal ridge, basal angle rounded in dorsal view, acute in lateral view; apex sharply rounded in lateral view, extending beyond tip of aedeagus. Ventrolateral part of apex of epiphallus extending downward and backward from dorsal part, unmodified. Dorsal bands simple, narrow after junction. Base of aedeagus tubular, narrow, tapering gradually to apex. Epandrium simple; each cercus ovoid with blunt ventroapical angle in lateral view, with fine, dense setae giving velvety appearance.

Female.—Similar to male.

Female genitalia (Figure 123).—Tenth tergum with about ten spines on each side. Ventral arm of ninth tergum narrow, acute apically, posterior margin curled toward meson medially. Dorsomedial angle of sclerite on each side of gonopore large, projecting dorsomedially as a broadly rounded lobe, broader than lateral arm which is slightly curved upward apically; ventral arm slightly curved laterad above, with sharp ventral point. Each duct of spermathecae about twice as long as bulb; first sections short, unsclerotized; second section about 1.5 times as long as bulb, sclerotized and covered with granular pubescence; third section short, clear; bulb ovoid with short stem.

Distribution.—Only three specimens of this species have been seen by the author. One is labeled "Chile. A. Faz," the second "Perales. I–26," and the third "Perales. I–25" and "Valparaiso, Chile. A. Faz." No specific type-locality is given, although it probably is the province of Santiago, Chile, since most of Philippi's types came from there. The specimen referred to below as *inappendiculatus* was collected at Majada Blanca, Manquehua, Coquimbo, Chile. This species probably occurs throughout central Chile and possibly in western Argentina.

Types.—The type of *Anthrax bellula* Philippi, which was presumably in the Santiago Muesum, has not been seen by the author. The specimens at hand agree perfectly with the description, however, and, as Philippi stated, *bellulus* cannot be confused with any other Chilean species. Philippi makes no mention of the presence of a sectoral crossvein on the wing, but from his description it may be inferred. Of the specimens examined, two have the crossvein present and the other has it present on one wing but not on the other.

According to notes by R. H. and E. M. Painter, the type female of *Spongostylum inappendiculatum* Bigot is in the Bigot collection of the British Museum. It is headless, as Bigot stated, but is otherwise well preserved. It carries the label "*Spogostylum inappendiculatum* ♀ Inédit. n. sp. Quinze Août 1888. J. Bigot, Chili."

A specimen in the collection of the author from Coquimbo, Chile, agrees well with the redescription and photograph of the type furnished by Dr. and Mrs. Painter. The two specimens apparently differ from

typical specimens of *bellulus* only in having the pigmentation on the wings reduced with the spots at the bases of cells R_4, M_1, and $2M_2$ absent or represented by faint clouds. Further collecting may show that *bellulus* and *inappendiculatus* are separate taxa, but with the limited number of specimens available, it seems best to regard them as one species.

Discussion.—Specimens of *bellulus* without spots at the bases of cells R_4, M_1, and $2M_2$ may be separated from similar species in northern and eastern South America by the reduced anal margin of the wing, dorsal and ventral patches of white scales on the metapleuron behind the spiracle, and by the presence of a sectoral crossvein on the wing. Characters separating typical specimens from *latibasis* and other related species are given under *latibasis*.

Anthrax minimaculatus Oldroyd

Anthrax minimaculatus Oldroyd, 1937, p. 83.

Male.—Basal antennal segments, legs, margins of thoracic pleura, and margins of abdominal segments reddish or orange. Front with black setae and linear gold scales. Face with mixed yellow and black setae and yellow scales. Occiput with fine yellow setae and yellow, gold and white scales; fringe of pile on posterior margin yellow with light tips. First antennal segment about 1.5 times longer than wide, cylindrical; second segment globular, slightly narrower than apex of first segment, base of third segment narrower than second segment, elongate globular, about three-fourths as long as styliform part, which is about 1.5 times longer than style.

Disc of mesonotum with fine black setae and mixed gold, yellow, and white, linear scales, few black scales medially on posterior half; lateral margins with longer, suberect, linear, gold, yellow and white scales, and coarse black setae and macrochaetae. Scutellum with gold, yellow and white, linear scales on margin and along mesal line, with linear black scales in submedial patches. Pile, setae, and scales on sternopleuron, mesopleuron, and anterior part of pteropleuron white, setae on last two yellow. Pile on prosternum, propleuron, and anterior margin of mesonotum yellowish white, some black hairs on latter; postalar tuft of pile white. Metapleuron with few lanceolate, white scales above and behind spiracle, bare below. Coxae with yellow setae and black scales.

Wing (Plate 6*e*) largely hyaline, cells C and Sc subhyaline. Light-brown spots present at bases of cells R_{2+3}, R_5, R_4, M_1, and $2M_2$, postmedially in cell R_1, extending from base of cell R_1 to base of cell Cu_1, and at bases of cells R, M, and 2A. Basal angle of vein R_4 with long spur, but not connected to vein R_{2+3} to form sectoral crossvein. R–m crossvein at basal two-fifths of cell $1M_2$; contact of cells $1M_2$ and Cu_1 about 1.5 times longer than width of base of cell Cu_1. Cell 2A slightly broader than cell 1A, not narrowed basally; alula well developed, posterior margin convex. Calypter subhyaline, fringe of hair white. Stem of halter yellow; knob yellow basally, white apically.

Femora and tibiae with ovate white scales except for few yellow scales anteriorly toward apices of femora. Middle femur with complete anteroventral row of macrochaetae; hind femur with complete anteroventral and posteroventral rows and few scattered dorsally at apex.

Lateral margins of first abdominal tergum with yellowish-white pile, few brown hairs posteriorly; posterior margin with fine, curly, yellow and white scales. Lateral margin of second tergum with white setae and scales anteriorly, with black setae and long, lanceolate, brown and white scales posteriorly; terga three and four with black setae and lanceolate-truncate scales, black anteriorly and white posteriorly; lateral margins of remaining terga with fine white setae and sparse, short white scales. Discs of terga with fine black setae and linear and lanceolate scales, white and yellowish white in medial transverse band on two, in mesal longitudinal spots and posterolaterally on posterior segments, mixed gold, yellow and white elsewhere, few black scales submedially at middle of two and submedially along anterior margin of three and four. Venter with fine white setae and lanceolate scales.

Male genitalia (Figure 129).—Gonocoxites broad basally, tapering with slight preapical emargination to broadly rounded apices in ventral view, narrow with acute apices in lateral view, medial sulcus narrow and shallow, deepening apically to separate distinct distal lobes; setae short, becoming sparse basally. Basal segment of gonostylus platelike, slightly rounded dorsally, extending to base of distal segment. Distal segment broadest mesolaterally, triangular basally, rounding dorsomedially to sharp apex; large, sharp, preapical tooth present laterally. Dorsal part of apex of epiphallus flattened dorsoventrally, with sharp, recurved basal spine; apex broadly rounded in dorsal view, mesal part raised and curved to apex in lateral view. Ventrolateral part of apex of epiphallus extending downward and backward from before apex, narrow, tapering, and

sharp distally. Dorsal bands simple, with row of fine erect setae before and after junction. Epandrium simple, with coarse setae; cercus oblong dorsoventrally, entirely pale, with fine yellow setae.

FEMALE.—Similar to male, judging from Oldroyd's description.

DISTRIBUTION.—*Anthrax minimaculatus* is known only from the type series from La Rioja, Patquia, Argentina.

TYPE.—The type female and 12 paratypes of *Anthrax minimaculatus* Oldroyd are in the British Museum. A photograph by R. H. and E. M. Painter shows the type female is in good condition. Although Oldroyd stated that the 12 paratypes were all females, the two paratypes loaned for study are males.

DISCUSSION.—*Anthrax minimaculatus* may be readily distinguished from both *bellulus* and *latibasis* by absence of a complete sectoral crossvein on the wing, and by absence of scales on the metapleuron behind and below the spiracle. In addition, it differs from *latibasis* by absence of a distinct, medially interrupted crossband of black scales on the second abdominal tergum; *bellulus* differs by having the posterobasal part of the wing reduced with the alula narrow and straight margined. *Anthrax minimaculatus* differs from other species in western South America by having a postmedial spot in cell R_1 of the wing.

Anthrax baliopteros, new species

MALE.—Integument mostly black, grayish to brownish pruinose; bases of femora, tibiae, proximal tarsal segments, apices of abdominal segments, and genitalia reddish orange. Front with fine black setae and lanceolate, semierect scales, yellowish white above and on each side of antennae, gold elsewhere. Face with mixed black and gold setae extending almost to antennae medially; few lanceolate, erect white scales along oral margin. Occiput with sparse black setae and linear and lanceolate, recumbent scales, white below emargination of eye, gold above; fringe of pile on posterior margin black behind gold scales, white behind vertex, mixed brown and white behind white scales. Antennae black, first two segments with black and white setae; first segment short, about as wide as long; second segment biscuit shaped, about half as long as wide; third segment with bulbous basal portion small, narrower than second segment, about as long as styliform portion which is twice as long as style.

Mesonotum with fine black setae and linear, recumbent gold and white scales; margins with semierect gold and white scales. Scutellum with fine black setae and linear scales, black in submedial spots, mixed gold and white on anterior margin, gold elsewhere. Mesopleuron, sternopleuron, and anterior part of pteropleuron with white setae and scales, mesopleuron with some gold macrochaetae above. Prosternum, propleuron, and anterior margin of mesonotum with white pile, few black setae present on latter. Postalar tuft of pile mixed gold and white. Metapleuron bare. Coxae with yellowish-white setae and white scales.

Wing (Plate 6*b*) hyaline with brown maculation; dark spots present in cell R_1 below tip of subcosta, at bases of cells R_{2+3} and R_5, and extending from base of cell Cu_1 to base of cell R_1; lighter spots at base of cell R_4 and extending along vein R_4 two thirds of way to apex, at base of cell M_1 and along vein M_2 and m crossvein, at base of cell $2M_2$, and apically in cell 1A; faint subhyaline areas near apices of veins M_1 and Cu_1. Cells C and Sc, and base of wing lightly infuscated, base of cell M darker. Veins R_{2+3} and R_4 with basal spurs about as long as basal sections. Contact of cells $1M_2$ and Cu_1 twice as long as base of cell Cu_1. R–m crossvein at basal two-fifths of cell $1M_2$; vein R_{2+3} arising opposite. Anal margin of wing well developed, alula broad with rounded posterior margin.

Legs with ovate-truncate scales, yellow anterodorsally at apices of femora, white elsewhere. Middle femur with anteroventral row of macrochaetae; posterior femur with complete anteroventral and posteroventral rows of macrochaetae and scattered macrochaetae anterodorsally toward apex.

Lateral margins of first abdominal tergum with dense white pile, with few black hairs posteriorly; posterior margin with few linear white scales on lateral thirds. Lateral margins of second tergum mostly with white pile, few semierect, lanceolate, yellowish-white scales posteriorly; lateral margins of terga three and four with short, lanceolate, erect black scales anteriorly and semierect, lanceolate, yellowish-white and yellow scales posteriorly; lateral margins of terga five, six, and seven with few black and yellow setae and some recumbent, lanceolate cuneate, white scales. Disc of second tergum with mixed gold and white, linear scales, predominantly gold posteriorly, two small submedial spots of linear black scales near posterior margin; terga three and four with linear gold scales on lateral and posterior margins, with linear yellow scales medially and linear black scales elsewhere; terga five

and six with small submedial spots of linear black scales, with mixed yellow and white, lanceolate scales medially and laterally, and linear gold scales between black and light scales; seventh tergum with mixed yellow and white, lanceolate scales medially, a few black scales submedially, linear gold scales sublaterally and a few lanceolate cuneate, yellow scales laterally. Venter with fine gold setae and small white scales.

MALE GENITALIA (Figure 131).—Gonocoxites broad basally, tapering to acute apices in both dorsal and lateral view; medial sulcus shallow, narrow, setae scattered from near apices to base. Basal segment of gonostylus simple, slightly rounded dorsally in lateral view, with small setaceous lobes apically in ventral view. Distal segment of gonostylus projecting dorsolaterally, dactylate with anterior margin narrowing postmedially to transversely broadened, sharply rounded apex. Dorsal part of apex of epiphallus with large, preapical, basally directed sharp spine in back of a deep, broad mesal emargination. Ventrolateral part of apex of epiphallus extending downward and backward from dorsal part, not notably modified. Dorsal bands simple. Base of aedeagus narrowly bulbous, tapering gradually to junction with ventral bands. Epandrium about one-third narrower than high, with coarse setae apically. Cerci not heavily sclerotized, with fine setae.

FEMALE.—Similar to male. Scales on front white below, yellowish white above. Postalar tuft of pile entirely white. Maculation of wings somewhat darker; fusion of cells $1M_2$ and Cu_1 only 1.5 times as long as width of base of cell Cu_1. Femora entirely yellow except for dorsoapical parts of posterior pair; macrochaetae on posteroventral side of posterior femur restricted to apex. Gold scales more extensive and yellow and white scales less extensive on abdomen.

VARIATION.—The only other specimen of this species available, a male, is similar to the holotype except that its wings have slightly less extensive pigment.

DISTRIBUTION.—The three specimens available indicate that *baliopteros* probably occurs throughout the drier tropical and subtropical areas of southern Brazil and Uruguay, and possibly into northeast Argentina and southern Paraguay.

HOLOTYPE.—♂, Bagé, Rio Grande do Sul, Brazil, 1 March 1961 (N. Marston-1) USNM).

ALLOTYPE.—♀, same data as holotype (USNM).

PARATYPE.—♂, Araraquara, São Paulo, Brazil, I-17-18-1941 (M. Carrera) (26146) (SASP).

DISCUSSION.—The holotype and allotype were collected along an overhanging bank of a stream near a patch of woods in the "campos" or grassland area of southern Rio Grande do Sul.

Anthrax baliopteros may be readily separated from other species with a postmedial spot in cell R_1 by the peculiar wing pattern in which the pigment runs along vein R_4, M_2 and the m crossvein from the bases of cells R_4 and M_1. The small apical spot in cell 2A also is distinctive.

Anthrax caatingensis, new species

FEMALE.—Face, lower part of front, first antennal segments, legs except apical tarsal segments, margins of thoracic pleura, posterior part of scutellum, posterior abdominal segments, and posterior margins of anterior abdominal segments reddish orange; remainder of body black. Front with black setae above, with mixed black and white setae and linear white scales below. Face with yellowish-white setae extending three-fourths of way to antennae and few linear white scales. Occiput with yellowish-white setae and lanceolate scales; fringe of pile on posterior margin white below, yellowish white above. First antennal segment about as long as apical width; second segment buttonlike; base of third segment bulbous, tapering to styliform part, which is about as long as base and about twice as long as style.

Disc of mesonotum with yellowish-white and brown scales, and fine setae; margins with yellowish, curly scales, gold setae and few black macrochaetae. Scutellum with lanceolate brown scales medially and yellowish-white scales along posterior margins. Sternopleuron, mesopleuron, and anterior part of pteropleuron with white setae and scales, some gold bristles dorsally on last two. Prosternum, propleuron, and anterior margin of mesonotum with white and yellowish-white pile. Postalar tuft of pile white. Metapleuron with patch of linear white scales above coxa. Coxae with white bristles and lanceolate scales.

Wing (Plate 6*d*) with light-brown spots postmedially in cell R_1, at bases of cells R_{2+3} and R_5, extending from base of cell Cu_1 to base of cell R_1, and at bases of cells R and M; anterobasal part of wing between spots yellowish brown to subhyaline. Basal angle of vein R_{2+3} with spur about as long as basal section; basal angle of vein R_4 with short spur about one-fourth as long as basal section. R–m crossvein at basal two-fifths of cell $1M_2$; vein R_{2+3} arising slightly basad. Contact of cells $1M_2$ and Cu_1 about twice as long as width of base of cell Cu_1. Cell 2A about 1.5 times as wide as cell

1A; alula well developed, posterior margin convex. Calypter subhyaline, fringe of hairs white. Stem of halter brown, knob brown basally, yellow apically.

Femora and tibiae with white and yellowish-white, lanceolate scales. Middle femur with incomplete anteroventral row of macrochaetae. Hind femur with anteroventral and anterodorsal rows of macrochaetae incomplete basally.

Lateral margins of first abdominal tergum with yellowish-white pile; posterior margin with curly, lanceolate, yellowish-white scales. Lateral margins of terga two through seven with white setae and some semirecumbent, lanceolate white scales, few black setae posteriorly. Discs of terga two through seven with sparse black setae, and linear and lanceolate scales, yellow and gold anteromedially, white posterolaterally, especially on posterior terga. Venter with fine white setae and ovate white scales.

FEMALE GENITALIA (Figure 122).—Tenth tergum with seven spines on each side. Ventral arm of ninth tergum narrow, apex not enlarged. Dorsomedial angle of sclerite on each side of gonopore not produced; lateral arm narrow, dorsal margin undulate, ventral margin curving up to acute apex; ventral arm narrow, curving mesad below. Each duct of spermathecae slightly longer than bulb, first section short and clear; second section about as long as bulb and covered with granular pubescence; third section very short before expanding to stem of bulb; bulb ovoid with stem about half as long as distal portion.

VARIATION.—The only other specimen available, a female, is similar in most respects to the holotype. The scales on the upper half of the occiput may be yellow.

DISTRIBUTION AND ECOLOGY.—The two specimens known of *caatingensis* were collected near a railway along the river just southwest of Mossoró. The area was typical caatinga; the soil was sandy and apparently plants derived subterranean moisture from the river. This species was taken along with *A. inaquosum* Marston. *Anthrax caatingensis* probably occurs throughout the desert area of northeastern Brazil.

HOLOTYPE.—♀, Mossoró, Rio Grande do Norte, Brazil, XII-4-1960 (N. Marston-1) (USNM).

PARATYPE.—♀, Mossoró, Rio Grande do Norte, Brazil, XII-5-1960 (N. Marston-2) (NLM).

The holotype is in good condition except that the abdomen is slightly rubbed, the mesonotum is slightly greasy, and one middle leg is missing. The paratype lacks one of the third antennal segments and the mesonotum and scutellum are greasy. Both specimens may be slightly teneral; for that reason the extent of the red body color has not been emphasized.

DISCUSSION.—*Anthrax caatingensis* differs from *baliopteros* by lacking spots of pigment at the bases of cells R_4, M_1, and $2M_2$. It may be readily distinguished from other species with a postmedial spot in cell R_1 by the absence of erect black scales on the sides of abdominal segments two, three, and four.

Anthrax mystaceus (Macquart), new combination

Spongostylum mystaceum Macquart, 1840, p. 53 [*Spogostylum*].—Kertész, 1909, p. 58.—Stuardo Ortiz, 1946, p. 92 [*Spogostylum*].

Anthrax duodecimpunctatus Philippi, 1865, p. 670 [*duodecimpunctata*].—Kertész, 1909, p. 35.—Edwards, 1930, p. 172 [*decempunctatus*].—Oldroyd, 1938, p. 84 [*duodecimopunctatus*].

MALE.—Body mostly black, purplish or bluish-gray pollinose; legs, sutures on pleura, posterior margins of abdominal sterna and basal antennal segment more or less orange. Front with black setae on upper three-fourths, with gold setae just above antennae; setae on lower two-thirds and lateral margins of face gold, a few black setae sometimes present medially, white setae sometimes intermixed along oral margin; scales on front white below, gold above. Occiput with scattered yellow setae and scales; fringe of pile on posterior margin yellow. First antennal segment about as long as apical width; second segment buttonlike, about as broad as base of third segment; base of third segment narrow, funnel shaped, tapering to styliform part which is one to three times as long as style.

Disc of mesonotum with fine black setae and linear, hairlike scales, white in submedial longitudinal bands and extending inward in front of wings, gold elsewhere; lateral margins with longer, fine white and yellowish-white, semirecumbent scales and gold bristles; posterior margin with curly, fine white scales. Scutellum with black setae and bristles and fine scales; white in lateral and posterior spots, gold elsewhere. Mesopleuron, sternopleuron, and anterior half of pteropleuron with white hairs and linear or lanceolate scales, some gold bristles on upper half of mesopleuron. Prosternum, propleuron, and anterior margin of mesonotum with yellowish-white pile, some black setae on latter. Metapleuron with dense tuft of white scales behind spiracle. Postalar tuft of pile white. Coxae with gold bristles and white scales.

Wing (Plate 6*i*) mostly hyaline; extreme base and spots at bases of cells R_{2+3}, R_4, R_5, M_1, $2M_2$, and Cu_1,

and in cell R below base of vein R_1 light brown. R–m crossvein near basal two-fifths of cell $1M_2$, vein R_{2+3} arising slightly basad; bases of veins R_{2+3} and R_5 with short spurs more or less as long as r–m crossvein. Contact of cells $1M_2$ and Cu_1 1.5 to 2.0 times as long as base of cell Cu_1. Cell 2A about as wide as cell 1A; alula well developed, posterior margin rounded. Calypter unpigmented, fringe of hairs white. Stem of halter yellow; knob brown basally, yellow apically.

Femora and tibiae with obovate and oblanceolate, truncate white scales, yellow scales sometimes present anterodorsally on femora and anteriorly on tibiae. Fore femur with scattered bristles anteroventrally toward base; middle femur with anteroventral row of bristles and one or several postmedially on anterior side; hind femur with complete anteroventral and posteroventral rows of bristles and some dorsally toward apex.

Lateral margins of first abdominal tergum with yellowish-white pile; lateral margins of posterior terga with black and yellow setae and yellow and white scales as continuations of dorsal bands, second tergum with some gold hairs anteriorly. First and second terga fringed with curly, fine white scales; terga three through seven with ovate and lanceolate white scales posterolaterally, becoming more extensive posteriorly; remainder of terga covered with linear gold scales except for mesally interrupted bands of linear black scales medially on two and anteriorly on three, four, and five. Sterna with scattered yellow setae and ovate white scales.

Male genitalia (Figure 134).—Gonocoxites narrow and parallel sided apically in lateral view, broad in ventral view, and curving inward apically before rounding to glabrous apices; medial sulcus narrow and deep; scattered fine setae present toward base. Basal segment of gonostylus not produced dorsally or apically, narrow in lateral view. Distal segment of gonostylus higher than broad with apex curled outward and ending in a sharp distal tooth and blunt medial tooth. Dorsal part of apex of epiphallus nearly transparent, tapering toward apex in dorsal view, extending beyond tip of aedeagus and bluntly rounded apically in lateral view; an angular projection extending backward above pigmented area formed from dorsal bands. Ventrolateral part of apex of epiphallus curving downward and backward to junction with ventral bands. Dorsal bands simple, broadly united before joining epiphallus. Epandrium simple, cerci unsclerotized and much broader than long.

Female.—Similar to male.

Female genitalia (Figure 126).—Tenth tergum with six spines on each side. Ventral arm of ninth tergum undulating, sharply rounded apically. Sclerite on each side of gonopore hatchet shaped; ventral arm parallel sided and slightly curved mesad below; lateral arm parallel sided, slightly turned upward apically to sharp dorsal angle. Each duct of spermathecae about 1.5 times as long as bulb; first section of duct short, second section slightly longer than bulb and covered with granular pubescence; third section short before expanding gradually to ovoid bulb.

Distribution.—The few specimens available of *mystaceus* indicate that it occurs in mountains of central Chile and northwestern Argentina. Specimens have been seen from "Cuesta, Pajonales," Valle Piquenes, Aconcagua; "Las Mercedes"; "C. Chile"; and "Chile."

Types.—The type specimen of *Spogostylum mystaceum* Macquart was not found by R. H. and E. M. Painter in a survey of type specimens of North and South America Bombyliidae in European museums. Macquart's rather brief description, however, indicates that it is the species described here. Macquart indicates that the wings are three times as long as the abdomen, but this character varies with telescoping of the abdominal segments. The legs were said to be black; specimens examined by the author vary only from red orange to about half black. Macquart's figure of the wing shows no spots at the bases of cells M_1 and $2M_2$, although his description indicates spots at the bases of all principal cells, which was true of all specimens examined by the author. Macquart's figure clearly indicates that the crossvein between veins R_4 and R_{2+3} is spurious, a common situation in the genus *Anthrax*. Only one of the specimens examined shows the character, and one has a short spur extending anteriorly toward vein R_{2+3} from the basal spur of vein R_4 (Plate 6*i*) in the same position as the crossvein figured. Other characters of the species agree with those described.

The type-locality given by Macquart is "du Bresil ou du Chili."

Mr. Luis Peña indicates that he has been unable to locate Philippi's bombyliid types in the Santiago Museum and that they may have been destroyed in an earthquake. Philippi's description of *duodecimpunctatus* indicates that he was referring to this species. The type-locality is the province of Santiago, Chile.

Discussion.—None of the characters given by Macquart in his description of the genus *Spongostylum*

have generic value as they are presently interpreted. The presence of a sectoral crossvein, particularly, varies between closely related species, and sometimes within species. Specimens with a spurious crossvein on one wing quite often lack it on the other, or have it in another position.

Anthrax mystaceus appears to be most closely related to *squalidus*, although they differ widely. It may be readily distinguished from *squalidus* and all other South American species of *Anthrax* by the dense patch of white scales on the metapleuron directly behind the spiracle.

Anthrax squalidus Philippi

Anthrax squalidus Philippi, 1865, p. 672 [*squalida*].
Argyramoeba squalida.—Kertész, 1909, p. 67.
Aphoebantus squalidus.—Edwards, 1930, p. 171.—Stuardo Ortiz, 1946, p. 92.
Argyramoeba crinita Bigot, 1892, p. 349 [*Argyromoeba*].—Kertész, 1909, p. 62.
Spongostylum crinitum.—Kertész, 1909, p. 92 [*Spogostylum*].—Edwards, 1930, p. 172 [*crinita*].—Stuardo Ortiz, 1946, p. 92 [*Spogostylum crinita*].

MALE.—Body black, tibiae and genitalia reddish; integument mostly bluish gray pruinose. Front with black setae and scattered linear white scales below. Upper half of face bare medially; eye margins and lower half of face with black setae, few yellow setae intermixed along oral margins. Occiput with scattered, short, mixed black and yellow setae; fringe of pile on posterior margin yellow. First antennal segment about two-thirds as long as apical width; second segment biscuit shaped, more flattened laterally; base of third segment conical, somewhat flattened mesolaterally, tapering to styliform part; style about one-sixth as long as third segment.

Disc of mesonotum with fine black setae and scattered, hairlike yellow scales, a few black scales postmedially; margins with longer setae and longer curly, hairlike white scales. Sternopleuron, mesopleuron, and anterior part of pteropleuron with sparse, erect, hairlike, white scales, dense black setae and some white pile present dorsally on last two. Propleuron, prosternum, and anterior margin of mesonotum with white pile, black setae intermixed on mesonotum. Hypopleuron, metapleuron, and posterior part of pteropleuron bare. Coxae with black and yellow setae and linear white scales.

Wing (Plate 6*h*) nearly hyaline, yellowish at base. R–m crossvein located at basal third of cell $1M_2$; vein R_{2+3} arising opposite, without basal spur. Vein R_4 with short basal spur about one-third as long as basal section. Contact of cells Cu_1 and $1M_2$ slightly longer than width of base of cell Cu_1. Cell 1A narrowly open. Cell 2A wider than cell 1A, alula not reduced. Calypter unpigmented, fringe of hair white, stem of halter yellow, knob yellow basally, paler apically.

Femora with ovate-truncate scales, black anterodorsally, white posteroventrally. Fore femur without macrochaetae; middle femur with anteroventral row; hind femur with anteroventral and incomplete posteroventral rows. Tibiae with black scales anteriorly, and white scales posteriorly.

First abdominal tergum with dense yellowish-white pile laterally. Lateral margins of terga two through seven with dense black and white pile, and long black setae. Discs of terga two through five with extremely fine, recumbent black scales anteromedially, their area decreasing posteriorly; remainder of discs of two through five, and six and seven with mixed yellow and white, fine, curly, recumbent and semirecumbent scales; all terga with long, erect black setae especially laterally and along posterior margins. Abdominal sterna with fine yellow setae, and fine, curly white scales.

MALE GENITALIA (Figure 130).—Gonocoxites broad, rounding to acute apices in lateral view, broadly rounded apically in ventral view; medial sulcus broad, gonocoxites folded over sulcus and meeting mesally at apex; setae scattered on gonocoxites from bases nearly to apices. Basal segment of gonostylus sharply rounded apically with a dorsomedial, truncate basal fold; a few fine setae present apically. Distal segment of gonostylus projecting dorsolaterally, cylindrical, tapering nearly to apex, which is slightly enlarged distally, with a narrow, dactylate lobe extending laterally from near base and curved upward apically. Dorsal part of apex of epiphallus extending upward like a hood in lateral view, dorsal margin bent downward to sharp apical angles, which extend above low, truncate, lateral projections; a deep, angular, mesal emargination defined by sharp angle present in dorsal view; a small nodelike projection present medially just above aedeagus. Ventrolateral part of apex of epiphallus projecting as narrow truncate lobes toward apex of aedeagus. Dorsal bands forming broadly angular, tapering, apically directed, lateral lobes before joining above aedeagus. Dorsal margin of epandrium curving downward to cerci; cerci sclerotized, triangular with sharp ventro-

apical angles, fitting over remainder of genitalia when in normal position.

FEMALE.—No females of this species have been studied. Notes by R. H. and E. M. Painter show the female type of *crinitus* (Bigot) has faint smoky brown pigment at base of cell R_4, base of cell R_5, and in the center of cell R of the wing. Both cells R_{2+3} and R_4 have recurrent stumps less than the length of the r–m crossvein at their bases.

DISTRIBUTION.—Only two specimens of this species have been seen by the author, both from 5 miles north of Laguna Dam, Coquimbo, Chile (Ross and Michelbacher, collectors). The type-locality is the province of Santiago, Chile.

TYPES.—The types of *Anthrax duodecimpunctatus, squalidus,* and *bellulus* Philippi were not found in any of the European museums R. H. and E. M. Painter visited in their study of types of North and South American Bombyliidae. Some of Philippi's types are said to be in the Santiago museum, but Mr. Luis Peña was unable to find them there. He stated (personal communication) that they may have been destroyed during an earthquake.

The type of *Argyramoeba crinita* Bigot is in the British Museum (Natural History). According to Painter and Painter (unpublished notes), it is a female carrying the labels "*Argyramoeba crinita* ♀ n. sp. Inédit. Août Quinz 1886. J. Bigot. Chili," and "Chili." It has been badly covered with fungus but is otherwise in good condition. A redescription of the type agrees well with specimens of *squalidus* except that the wings have slightly more pigment and cells R_{2+3} and R_4 have distinct spurs basally.

DISCUSSION.—Edwards (1930) erroneously referred this species to the genus *Aphoebantus*. He apparently mistook Philippi's statement that the bases of cells R_{2+3} and R_5 have recurrent spurs to mean that vein R_{2+3} arises before the r–m crossvein. The two specimens seen by the author do not have the recurrent spurs mentioned by Philippi, but this is a highly variable character. The long, erect black setae mentioned in the description are distinctive. Also, Philippi specifically mentioned setae at the tip of the third antennal segment, which are not found on the antennae of New World species of Lomatiinae.

Anthrax plurinotus (Bigot)

Argyramoeba plurinota Bigot, 1892, p. 350 [*Argyromoeba*].—Kertész, 1909, p. 66.

Anthrax plurinotus.—Edwards, 1930, p. 172 [*plurinotata*].—Stuardo Ortiz, 1946, p. 93.

MALE.—Body mostly black, pleural sutures, margins of abdominal segments, tibiae, and basiventral parts of femora reddish orange. Front with black setae and few white scales; face completely covered with black setae, few white setae along oral margin. Occiput with fine black setae and scattered, lanceolate white scales; fringe of pile on posterior margin white below, mixed black and white above, white behind vertex. First and second antennal segments closely joined, first segment shorter than apical width; second segment spherical but flattened basidistally; base of third segment flattened, styliform part arising from outer half, about as long as style.

Disc of mesonotum with black setae and black, white and gold, linear scales; posterior margin and lateral margins in front of wings with curly, lanceolate scales. Scutellum with black setae and linear scales, white on anterior half, gold on posterior half. Sternopleuron and mesopleuron with yellow setae and linear and lanceolate white scales, some gold setae on upper half of mesopleuron. Pteropleuron bare; metapleuron bare. Prosternum, propleuron, and anterior margin of mesonotum with white pile, some black setae on latter; postalar tuft of pile yellow. Coxae with black and white setae, and linear and lanceolate, white scales.

Wing (Plate 6*a*) pigmented light brown basally and anteriorly out to tip of vein Sc in cell R_1, to bases of cells R_{2+3}, R_5, $1M_2$, Cu_1, and into basal third of cell 1A; slightly darker spots present at bases of cells R_1, R_{2+3} and R_5, R_4, M_1, $2M_2$, and Cu_1, no isolated spot present postmedially in cell R_1. R–m crossvein about halfway from base to apex of cell $1M_2$, vein R_{2+3} arising about length of r–m crossvein basad; contact of cells $1M_2$ and Cu_1 about three times longer than width of base of cell Cu_1. Vein R_{2+3} without basal spur, vein R_4 with short basal spur. Cell 2A narrower than cell 1A, alula reduced, posterior margin straight. Calypter subhyaline, fringe of hairs yellowish white. Stem of halter yellowish brown, knob brown basally, yellow at tip.

Scales on femora mostly white, black scales anterodorsally toward apices, especially on fore and middle pairs. Hind tibia with black scales dorsally and white scales ventrally; fore and middle pairs with white scales. Middle femur with anteroventral row of macrochaetae; hind femur with anteroventral and posteroventral rows of macrochaetae and some scattered dorsally toward apex.

Lateral margins of first abdominal tergum with white pile, posterior margin with lanceolate and ovate, white and gold scales. Lateral margins of terga two through seven with scattered black setae and few appressed, white scales. Discs of terga two through seven with scattered black setae; second tergum with anterior band of linear gold scales followed by band of linear black scales interrupted medially by yellow scales, posterior margin with lanceolate and ovate, yellow and white scales; third and fourth terga with medially interrupted bands of black scales anteriorly followed by gold scales, then white scales along posterior margins; fifth, sixth, and seventh terga with black scales anteriorly, and white scales posterolaterally and medially. Venter with scattered black and yellow setae and white lanceolate scales.

MALE GENITALIA (Figure 135).—Gonocoxites broad basally in ventral view, narrow apically with sharp apices in lateral view; mesal margins curving concavely to sharp lateral apices in ventral view; setae scattered over apical parts. Basal segment of gonostylus short, concave dorsally with rounded apex in lateral view. Distal segment of gonostylus ovate, dorsoapical margin curled slightly laterad. Dorsal part of apex of epiphallus forming bluntly rounded preapical, dorsal angle and right-angled apex in lateral view, narrow with shallow apical emargination in dorsal view. Ventrolateral part of apex of epiphallus not well defined from simple, broad dorsal bands, extending downward and backward from dorsal part. Base of aedeagus narrow, cylindrical, tapering to apex.

DISTRIBUTION AND TYPE.—The type male of *Argyramoeba plurinota* is in the Bigot collection of the British Museum. According to notes made by R. H. and E. M. Painter, it carries the labels "*Argyromoeba plurinotatus* [sic] n. sp. Inédit. Quinze Août 1888. J. Bigot. Chile" and "Chile." It is in good condition except that the left antenna is broken; the abdomen is mashed so the genitalia are twisted and concealed. The specimen may be somewhat teneral.

Only one specimen of this species has been seen by the author, a male labeled "Llao-Llao, Argentina, 8-I-962." It agrees perfectly with a redescription of the type made by Painter and Painter, with minor exceptions due to the slightly teneral condition of the type. The species probably occurs throughout central Chile and western Argentina.

Anthrax plurinotus differs from those species lacking a postmedial spot in cell R_1 on the wing by having the setae extend onto the upper half of the face below the antennae and by having a completely bare pteropleuron.

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Anthrax tigrinus Group

The *tigrinus* group is a small assemblage of species of distinctive appearance that are parasitoids of carpenter bees so far as known. The species cannot be confused with those of any other group in the genus. The distinctive crossvein between the m crossvein and vein Cu_1 on the wing (Plate 6*j–n*) will readily separate them from their congeners. In addition, the large size of the specimens and the unusual wing pattern with pigment expanded along the veins to form bands are peculiar to the group.

The study is based on approximately 450 specimens, the majority available from museums in North and South America. The localities of the specimens range from extreme southeastern Canada, throughout eastern and southwestern United States, north along the Pacific coast to southern Oregon, along both coasts of Mexico, and south into Central America. Only one South American specimen is available (from Venezuela), so that conclusions regarding the Neotropical distribution of the group are purely conjectural. Further collecting may show that there are additional species from South America, or that the distribution of *simson simson* includes the Amazon Basin and southeastern Brazil. The numerous species of Neotropical carpenter bees make it probable that at least one species of the group occurs in that area.

Four names have been proposed in the group. Until now, however, all have been generally regarded as synonyms and the entire group has been considered one species. Here, five taxa have been discriminated. *Anthrax tigrinus, delila,* and *simson* are regarded as good species while *scriptus* is a synonym of *tigrinus*. In addition, one species, *xylocopae,* and one subspecies, *simson habrosus,* are described as new.

Group Description

Body mostly reddish brown to orange; mesonotum, upper half of occiput and sometimes third antennal segment and anterior abdominal terga black. Pruinosity mostly gray or brown, silver along eye margins. Head globoid, slightly higher than long; eyes separated by about 2.5 to 3.0 times width of ocellar tubercle; antennal sockets separated by about 2.0 to 2.5 times their

diameter, about 1.5 to 2.0 times their diameter from eye margin. Antennal area and face produced distinctly above eye margins, face rounded to oral cavity. Anterior tentorial pits forming deep cavities separating face from genae. Front covered with numerous black or reddish setae, denser on upper third, and sparse, lanceolate, black to yellowish-white scales. Lower half and lateral margins of face with dense, black or reddish setae, and intermixed, gold to white, erect lanceolate scales, setae occasionally extending along midline to join those on front. Genae with sparse black or reddish setae. Occiput with sparse black, gold, or mixed setae and black or yellow scales; fringe of pile on posterior margin yellow to black with lighter tips above, becoming lighter below. First antennal segment cylindrical or slightly enlarged apically, about as long as or slightly shorter than apical width. Second segment short, cup-like, longest dorsomedially, with apical margin forming a sharp flange surrounding base of third segment. Base of third segment broadened dorsoventrally, rounded; styliform part arising near outside edge above middle, narrow, about as long as dorsoventral width of base; style very short, with few fine setae apically. Setae on first and second segments black.

Mesonotum with fine setae scattered over disc and with coarser setae and bristles along posterior margins. Scales mostly linear and curly, dense, black in broad, longitudinal, sublateral bands broken dorsoanteriorly to base of wing, and in submedial spots of variable size on posterior half, mixed reddish brown and white elsewhere. Setae on scutellum fine and black; scales lanceolate, white laterally and in posterior patch, sometimes gold in anteromedial patch. Macrochaetae on mesonotum and scutellum varying from red to black. Pile on upper margin of mesopleuron and humeral callus white, bristles red or black. Pile and scales on remainder of mesopleuron, sternopleuron, and anterior half of pteropleuron white, red or black; setae red, yellow, or black. Posterior part of pteropleuron and hypopleuron bare. Metapleuron bare except for small patch of setae and scales above hind coxa. Pile on prosternum, propleuron, and anterior margin of mesonotum black, white, or red. Postalar tuft of pile white. Coxae with black or red setae and black, white, or gold scales.

Wing (Plate 6*j–n*) pigmented with light to dark brown spots and bands along veins and at bases of cells, hyaline elsewhere. Cells C and Sc light brown to subhyaline except for hyaline areas after humeral crossvein. Base of wing into basal parts of cells R, M, 1A, and 2A pigmented. More or less coalesced spots extending from tip of vein 2A across bases of cells Cu_1, $1M_2$, and $2M_2$ to bases of cells R_1, and R_{2+3} and R_5. Pigment usually extending along vein R_{4+5} to base of cell R_4 and R_5 to wing margin. More or less coalesced spots at bases of cells M_1 and $3M_2$, apically on veins R_{2+3}, M_1, M_2, and Cu_1, preapically on vein R_{2+3}, and in cell R_1 below apex of vein Sc. Veins yellow to dark brown or red. Base of cell R_4 with long or short spur, or connected to vein R_{2+3} to form complete sectoral crossvein; medial angle with short spur. Base of cell R_{2+3} with short spur, arising at or near r–m crossvein, which is about at middle of cell $1M_2$. Spurious vein between m crossvein and vein Cu_1 (rarely incomplete). Contact of cells $1M_2$ and Cu_1 one-fifth to one-half as long as width of base of cell Cu_1. Cell R_5 broadly open. Cell 1A narrowly open or closed at wing margin. Cell 2A and alula broadened, wider than cell 1A. Calypter unpigmented, fringe of scalelike hairs brown nearest wing, white otherwise. Stem of halter yellow to dark brown, knob light brown to black, tip yellow.

Scales on legs brown or black. Fore femur with poorly defined anteroventral row of weak or strong macrochaetae. Middle and hind femora with anteroventral rows of weak to strong macrochaetae (sometimes incomplete). Few macrochaetae sometimes present anterodorsally toward apex. Fore tibia with anterodorsal, posterodorsal, and posteroventral rows of macrochaetae. Middle and hind tibiae with more or less complete rows of macrochaetae at all angles; anterodorsal row on hind tibia double, with semierect scales intermixed.

Sides of first abdominal tergum with dense, long pile; sides of posterior terga with sparse or dense, short pile anteriorly and a few setae and scales posteriorly. Posterior margin of first tergum with lanceolate scales, long, dense and white laterally, sparse and brown or white medially; black or red setae present medially. Discs of remaining terga with fine black or red setae and small, oblanceolate or obovate scales. White scales in large posterolateral spots on two, five, and six, and in small spots posterolaterally on three and four, and submedially on posterior margins of two through seven (absent on seven in female); white patches more or less coalesced on posterior terga; white scales sometimes present anteromedially on two and brown scales sometimes present along posterior margins. Venter with dense black or red setae and dense, ovate, black or black and white scales.

Gonocoxites of male genitalia (figure 127) divided basally, basal lobes curving sharply mesad, then distally

again before joining about halfway to apices; lateral margins curving gradually to sharp apices in lateral view, lateral margins curving forward then mesad to broadly rounded, small apices in ventral view; apices separated by broad shallow sulcus; medial parts of gonocoxites swollen before curving to flat apices, setae moderately numerous. Basal segment of gonostylus a small, flat plate, about as broad as long. Distal segment formed dorsolaterally, about three times as long as basal width in lateral view, bifurcated at apical third into basally curved, acutely tipped proximal section and broad, flat distal section with acute distolateral tip curved upward in lateral view, acuminate apically to bifurcate apex in dorsal view, with high, dorsally curved carina with short, sharp, upcurved proximal end. Dorsal bands long and narrow, uniting about two-thirds of way to dorsal carina. Aedeagus highly modified, with vestigial basal part and long, bowed, flat, narrow distal part curving dorsoproximally and in a semicircle down and under epiphallus. Apodemes at base of aedeagus small and upside down in relation to the genitalia of other species of *Anthrax* observed. Ventral bands extending proximally and uniting with aedeagus at the proximal arc. Epandrium deeply emarginate proximally in dorsal view, with long, apically expanded ventral lobes, with numerous strong setae on apical part. Cerci unsclerotized, with fine setae.

Eighth tergum of female genitalia (Figure 121) with dense, fine hairs extending apically; medial, proximal process short, flattened laterally, broadly rounded dorsally and straight ventrally in lateral view. Ventral arm of ninth tergum narrow medially, bending proximally and slightly upward at slightly expanded apex; an interior preapical flange extending ventrally over edge of sclerite on each side of gonopore; ninth tergum with numerous, fine long hairs apically. Tenth tergum with 22 to 32 stiff spines apically on each side surrounding the cerci; ventral arm broadened parallel to meson, bent inward apically. Sclerite on each side of gonopore broadened parallel to meson; apex bent sharply outward, with broadly rounded distal section and sharp, uncurved proximal tooth; basal section narrow, bent downward and laterally. Spermathecae emptying into large, membranous sac extending inward; ducts uniting before emptying into sac, long and narrow, flexible, convoluted; medial sections more or less sclerotized; bulbs obovate or oblanceolate in outline, one bulb distinctly larger than other two.

Evolution

Superficially, the species of the *tigrinus* group seem to have no close affinities with species of other groups of *Anthrax,* but on closer examination they have many characters in common with the *pluto* subgroup of the *oedipus* group. The saucer-shaped second antennal segment, wing venation, distribution of spots on the wing and pattern of scales on the thorax and abdomen are similar. Also, species of both *oedipus* and *tigrinus* groups have similar habits; both parasitize hymenopterous insects nesting in wood or other similar habitats. The species of the *tigrinus* group simply have become more specialized in that they are restricted to carpenter bees so far as known. The two groups may have evolved from a common ancestor early during the Pleistocene.

Anthrax delila shows the least specialized characters in the *tigrinus* group, which may indicate that the group was derived from an ancestral stock occurring in south-central California. If so, a possible line of evolution in the group might be as follows (Figure 7). During the Illinoian (third) glacial period the cool wet climate allowed a connection between the forests of eastern Arizona and southern California by way of southern Nevada, and through southern Texas to southeastern United States and eastern Mexico. The ancestral form, adapted to forested areas, could have followed that route and successfully colonized the areas. During the following interglacial period, the dry climate broke the forest connections, allowing four populations to differentiate—*delila* remaining in California and retaining primitive characters in its stable environment, *xylocopae* becoming adapted to dry forests of eastern Arizona, *tigrinus* expanding throughout deciduous forests of eastern United States, and *simson* becoming adapted to tropical forests of southern and eastern Mexico. During the Wisconsin (fourth) glaciation the forests were again connected, but no great changes would have taken place since the available habitats were occupied. However, the population of *simson* adapted to dry climate in southern Mexico probably would have been isolated from that in the wet forests of eastern Mexico and Central America by the cold uplands at the Isthmus of Tehuantepec, allowing it to differentiate to form the present subspecies, *simson habrosus,* which would have been able to migrate northward to fill the vacant ecological area in the deserts of Sonora, western Arizona, southern California, and Baja California. *Anthrax delila* probably

colonized southern Baja California during the last glacial period. A population has since been isolated there by the recent trend toward warmer and drier climate in that area. The relatively slight differentiation that has taken place does not seem to warrant naming a distinct subspecies.

The fact that the Florida population of *tigrinus* has not diverged from those in the remainder of the eastern United States tends to substantiate the evolutionary scheme given above. Since populations of other species of *Anthrax* isolated in Florida during the interglacial periods show distinct differences from mainland populations, it seems probable that *tigrinus* did not arrive in the southeastern United States until the third interglacial period and did not migrate into Florida until it was reconnected during the fourth glacial period.

Populations of *simson* may not have crossed the Isthmus of Panama until the fourth glacial period, since the one specimen available from Venezuela is not noticeably different from specimens of *simson* from Central America. If that is the case, any populations found in the Amazon or southeast Brazil probably will not be noticeably different from the Central American population.

Taxonomic Characters

The species of the *tigrinus* group all are quite similar in general appearance so characters used to separate them are rather inconspicuous. None of the characters has been mentioned heretofore in the literature except that Loew noted the comparatively small, rounded spots in the outer part of the wing of *delila*.

The wing pattern is essentially similar in all species of the *tigrinus* group, although the wing of *delila* has the spots at the bases of cells M_1, $2M_2$, and $3M_2$ small, rounded, and more or less discrete from each other and the spots on the apices of veins M_1, M_2, and Cu_1. This results in the separation of the spots at the bases of cells $2M_2$ and $3M_2$ along vein Cu_1, which is the most important diagnostic character for *delila*. In other species, the spots in the apicoposterior part of the wing are larger and expand along the veins to form bands. The wing pigment is dark brown in *xylocopae* and *tigrinus*, and is similar, but less intense, in *delila*. In the subspecies of *simson* the pigment is more reddish brown, especially in males. Females have darker and more extensive pigment than males in all species.

The wing veins are dark red or dark brown in *tigrinus, delila,* and *xylocopae,* whereas in the subspecies of *simson* they are yellow or light red and contrast with the surrounding pigment. The light veins add to the reddish-brown appearance of the wings of *simson simson* and *s. habrosus*. The venation is essentially similar in all of the species, but in most specimens of *s. habrosus* the spur at the basal angle of cell R_4 is elongate and connected to vein R_{2+3} to form a sectoral crossvein. This crossvein is incomplete in some specimens, sometimes on only one wing, but then the spur is more than twice as long as the r–m crossvein, whereas in the other subspecies it is usually less than twice as long as the r–m crossvein. The crossvein between the m crossvein and vein Cu_1, which is used as a diagnostic character for the *tigrinus* group, has not been noted in any other species of Bombyliidae. It is a stable character, incomplete in only one of the specimens studied. In that case, short spurs on the m crossvein and vein Cu_1 indicated its position.

The vesture of the body in general offers no good characters to separate the species. Scales and hairs of different colors vary greatly in extent between individuals and between sexes. The color of the pile on the lateral margins of the first abdominal tergum, however, is a good diagnostic character in one case. In *tigrinus,* the pile is black or reddish black on the lower half and white on the upper half, whereas in other species dark hairs occupy the anteroventral portion and extend onto the dorsal surface anteriorly. In *delila,* a few specimens from southern California and those from Baja California have the pile almost entirely white or yellowish white with no dark hairs dorsally, but these specimens may be readily separated from *tigrinus*.

Unlike other groups of *Anthrax,* the male genitalia of the *tigrinus* group show no significant variation between species. Their highly modified structure is peculiar to the *tigrinus* group and they show no relationship to those of any other species in the genus in North and South America. The female genitalia are less highly modified, but they also show little variation between species. In specimens examined, the number of spines on the tenth tergum varies from 22 to 32. Also, the sclerites on each side of the gonopore and the bulbs of the spermathecae vary somewhat in form, but in other respects the genitalia are quite similar. A distinct feature of the *tigrinus* group is that one bulb of the spermathecae is larger than the other two.

Key to the North and South American Species of the *Anthrax tigrinus* Group

1. Spot at base of cell $3M_2$ of wing (Plate 6*k–n*) broadly connected along vein Cu_1 to spot at base of cell $2M_2$; spots in outer part of wing expanded as bands along veins 2
   Spot at base of cell $3M_2$ of wing (Plate 6*j*) not connected along vein Cu_1 to spot at base of cell $2M_2$ (narrow thread of pigment rarely present above vein); spots in outer part of wing rounded, not expanded as broad bands along veins (except on R_4 and R_5). California and southern Baja California (Map 26) ..... ***delila*** Loew

2(1). Spur at base of cell R_4 of wing (Plate 6*k, m–n*) not connected to vein R_{2+3}, usually less than 2.0 times longer than r–m crossvein 3
   Spur at base of cell R_4 of wing (Plate 6*l*) connected to vein R_{2+3} to form complete sectoral crossvein, or, if not connected, spur at least 2.0 times longer than r–m crossvein. Southern California, Baja California, Arizona, and southeast along coast of Mexico to Chiapas (Map 27) ..... ***simson habrosus***, new subspecies

3(2). Lateral margins of first abdominal tergum with black hairs on anterior part of upper surface. Arizona to Texas, Gulf coast of Mexico, Central America, and eastern and northern South America 4
   Pile on lateral margins of first abdominal tergum white above, black or brown below, sometimes with white hairs below, but without dark hairs anterodorsally. Extreme southeast Canada and eastern United States as far west as central Texas (Map 27). ..... ***tigrinus*** (DeGeer)

4(3). Veins on wing (Plate 6*m*) dark red or brown, not contrasting with dark brown pigment. Central Texas to eastern Arizona and into north-central Mexico (Map 26) ..... ***xylocopae***, new series
   Veins on wing (Plate 6*k*) light reddish brown, contrasting with surrounding pigment. Gulf coast of Mexico, Central America, and eastern and northern South America (Map 27) ..... ***simson simson*** Fabricius

Anthrax delila (Loew)

Argyramoeba delila.—Loew, 1869, p. 28.—Loew, 1872, p. 142.—Osten Sacken, 1877, p. 241.—Osten Sacken, 1878, p. 90.—Coquillett, 1894, p. 95.—Kertész, 1909, p. 67.
Spongostylum delila.—Aldrich, 1905, p. 222 [*Spogostylum*].—Nininger, 1916, p. 162.
Anthrax delila.—Painter and Painter, 1965, p. 432.
Argyramoeba simson.—Davidson, 1893, p. 153 [not Fabricius, 1805; misidentification].
Spongostylum simson.—Aldrich, 1905, p. 223 (part) [*Spogostylum*] [not Fabricius, 1805; misidentification].
Anthrax simson.—Priddy, 1939, p. 45.—Hurd, 1959, p. 54 [not Fabricius, 1805; misidentification].

MALE.—Setae on front and face mostly black or reddish brown, gold setae sometimes present on face and lower part of front; scales on upper part of front usually black, on lower part mixed gold and yellowish white, on face mixed white and yellowish white. Fringe of pile on posterior margin of occiput gold or light brown basally, with white tips, rarely entirely white.

Scales on mesopleuron, sternopleuron, and anterior part of pteropleuron white or yellow, black scales sometimes on anterodorsal part of pteropleuron; setae usually black, sometimes partly reddish brown, or partly or entirely yellow. Prosternal pile usually mixed brown and white, sometimes entirely brown or entirely white. Propleural pile usually white or yellowish white, sometimes partly or largely brown. Scales on coxae mixed yellowish white, white and black or entirely white.

Wing pattern as in Plate 6*j*. Spots in outer part of wing not elongated along veins except on veins R_4 and R_5; spots at bases of cells M_1 and $3M_2$ separated from spots at apices of veins M_1, M_2, and Cu_1; spots at base and apex of cell $2M_2$ not connected along vein Cu_1, or only very narrowly connected by thin thread of pigment. Vein dark brown, of same color as pigment or darker. Base of vein R_4 with short spur, but not connected to vein R_{2+3} to form sectoral crossvein.

Pile on lateral margins of first abdominal tergum usually entirely white, sometimes partly brown or black anteroventrally. Dorsum of abdomen with some brown scales in addition to black and white scales. Setae on venter black to yellowish, scales entirely white, or rarely with few black scales on first sternum and anterior part of second.

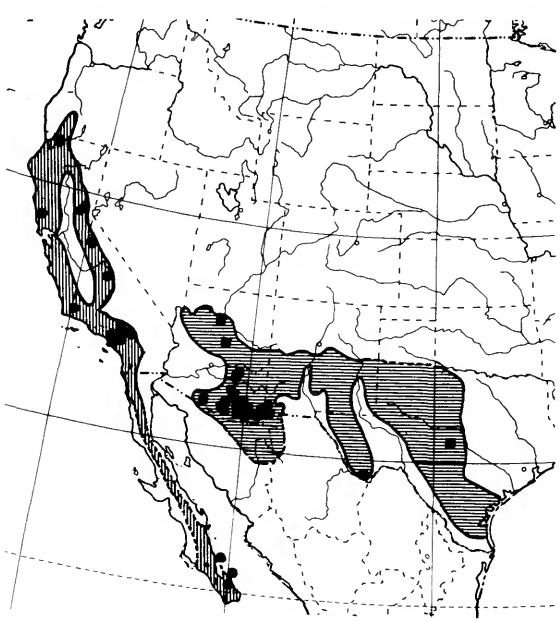
MALE GENITALIA.—See group description and Figure 127.

FEMALE.—Similar to male. Pile on prosternum and propleuron entirely brown or black or with some white hairs, rarely predominantly white. Setae on remainder of pleura and coxae black. Scales on mesopleuron,

sternopleuron, and anterior part of pteropleuron white or yellowish white, black scales usually present on upper half of sternopleuron. Wing pattern slightly more extensive than in male, but spot at base of cell $3M_2$ not joined to those at bases of cells M_1 and $2M_2$. Pile on lateral margins of first abdominal tergum usually black or dark brown on anteroventral half to three-fourths, rarely almost entirely white. Setae and scales on venter of abdomen entirely black or few white scales present along posterior borders, especially posteriorly.

FEMALE GENITALIA (Figure 121).—Ninth tergum with about 22 spines on each side. Middle sections of ducts of spermathecae lightly sclerotized, only slightly darker than other sections; smaller bulbs oblanceolate in outline, about 2.75 times longer than maximum diameter; larger bulb obovate, about 2.0 times maximum diameter.

DISTRIBUTION AND ECOLOGY.—*Anthrax delila* occurs in forested areas from northern California south along the Coast Range and the west side of the Sierra Nevada into the mountainous area north and east of Los Angeles, and at the southern tip of Baja California Sur, Mexico; perhaps also in forested areas in extreme southwestern California and on mountains in central and northern Baja California (Map 26).



MAP 26.—Distribution of *Anthrax delila* (dots and vertical lines) and *A. xylocopae* (squares and horizontal lines).

TYPE.—The type male of *Argyramoeba delila* Loew is in the Museum of Comparative Zoology, Harvard University. Notes on the type made by R. H. Painter indicate that it is the species described here. The type specimen is lighter than most specimens of the species, with numerous brown scales and few black hairs on the dorsum of the abdomen. The type-locality is "California."

BIOLOGY.—*Anthrax delila* has been reared from the nests of *Xylocopa tabaniformis orpifex* Smith by Nininger (1916) and Davidson (1893). Hurd (1959) reviewed information provided by them. The life cycle is typical of the species of *Anthrax* studied.

DISCUSSION.—Three males and one female collected in southern Baja California differ from typical California specimens by the lighter pile and scales on the thorax and abdomen. Males have the pile on the prosternum, propleuron, and first abdominal tergum entirely white or yellowish white, and the setae and scales on the mesopleuron, sternopleuron, and anterior part of the pteropleuron yellow and white. The female has only a few brown hairs on the propleuron and first abdominal segment while the prosternum is black haired. Setae on the remainder of the pleura are black, while the scales and pile are white and yellowish white. Since a male similar in all respects to those from southern Baja California has been taken with several darker males at Monrovia Canyon, Los Angeles County, California, the two populations are regarded as conspecific. Separation of the populations is probably a recent result of the progressively drier climate since the last glacial period. Intermediate populations, however, may still exist on the mountains in central and northern Baja California.

Anthrax delila differs from other species in the *tigrinus* group by the separation of the spots at the bases of cells $2M_2$ and $3M_2$ on vein Cu_1 by a broad hyaline area. In a few specimens an almost imperceptible thread of pigment exists along vein Cu_1, but never a broad band as in other species. *Anthrax delila* is partially sympatric with *simson habrosus* in southern California and Baja California. However, *delila* apparently is indigenous to wetter, forested areas, whereas *s. habrosus* occurs in drier, desert habitats. In addition to the character given above, *s. habrosus* may be distinguished by a complete sectoral crossvein or by having the spur at the base of cell R_4 at least twice as long as the r–m crossvein.

Anthrax xylocopae, new species

Argyramoeba tigrina.—Kertész, 1909, p. 67 [part] [not DeGeer, 1776; misidentification].

Anthrax tigrinus.—Maughan, 1935, p. 32 [*tigrina* (DeGeer)].—Painter and Painter, 1965, p. 432 [part] [not DeGeer, 1776; misidentification].

Anthrax simson.—Hurd, 1959, p. 57 [not Fabricius, 1805; misidentification].

MALE.—Setae on front, face, and genae black; scales on front mostly black, some white ones laterally below; scales on face white. Fringe of pile on posterior margins of occiput dark brown with light tips. Pile on prosternum and propleuron black. Setae and scales on mesopleuron, sternopleuron, anterior part of pteropleuron, and coxae black, few light scales posteriorly on pteropleuron.

Wing pattern as in Plate 6*m*; pigment dark brown, veins slightly darker. Pigment in outer part of wing expanding along veins to form bands; pigment at base of cell $3M_2$ connected to that at bases of cells M_1 and $2M_2$. Vein R_4 with short spur at base, not connected to vein R_{2+3} to form sectoral crossvein.

Scales on dorsum of abdomen entirely black except for patches of white scales along posterior margins of segments. Pile on lateral margins of first tergum black on anteroventral three-fourths, white posterodorsally. Venter of abdomen with black setae and scales, few white scales present along margins of posterior terga.

MALE GENITALIA.—See group description and Figure 127.

FEMALE.—Similar to male. Black scales medially on face. Scales on mesonotum entirely black.

FEMALE GENITALIA.—Similar to *simson habrosus* (Figure 121). Ninth tergum with about 28 spines on each side. Middle sections of ducts of spermathecae lightly sclerotized; smaller bulbs of spermathecae obovate in outline, about twice maximum width; third bulb distinctly larger than other two.

VARIATION.—The white scales on the front may be more extensive than in the types. White scales may be absent from the abdominal venter in females, or may be present across the apices of all segments in males. The pile on the sides of the first abdominal tergum may be as much as nine-tenths black. The pigment on the m crossvein may be narrowly broken between the bases of cells M_1 and $3M_2$.

DISTRIBUTION AND ECOLOGY.—*Anthrax xylocopae* occurs in areas of desert grassland and probably also in pinion–juniper forests from western Texas to central Arizona (Map 26). It also occurs in northwestern Mexico, possibly farther south on the central plateau than shown on the map. A specimen from Zion National Park, Utah (Maughan, 1935), may be either *xylocopae* or *simson habrosus*. In either case, the distribution of the species must extend into southern Utah.

HOLOTYPE.— ♂, 7 mi. SE Rodeo, Hidalgo Co., N. Mex., VIII–21–1958 (M. A. Cazier) (UCAL).

ALLOTYPE.—♀, 7 mi. SE Rodeo, Hidalgo Co., N. Mex., VIII–21–1958 (C. G. Moore) (UCAL).

PARATYPES.—Arizona: *Cochise Co.*, 3♂, Carr Canyon, Huachuca Mts., VIII–1905 (H. Skinner) (ANSP); 2♂, Huachuca Mts. (ANSP); ♀, Huachuca Mts. (Oslar) (ANSP); ♂, Huachuca Mts., VII–15–1934 (Ar. E. D. Ball) (ARIZ): ♂, Huachuca Mts., VIII–22–1935 (Jean Russell) (RHP); 2♂, Ramsey Canyon, Huachuca Mts., IX–5–1955 (F. G. Werner and G. D. Butler) (ARIZ); ♀, Portal (N. Mex.), IX–2–1958 (H. V. Weems, Jr.) (FSPB); 3♂, 5 mi. W Portal (N. Mex.), VIII–6, 12–1958 (P. Opler) (UCAL, LINSDALE). *Coconino Co.*, ♀, Bright Angel Trail, Grand Canyon VIII–4–1917 (R. C. Shannon) (Cornell U. Lot 869, Sub. 2) (CNLL); 3♂, Oak Creek Canyon, VIII–17, 22–1954 (K. Doering) (KANS, NLM); 2♂, ♀, Oak Creek Canyon, VIII–5, 9–1961 (G. C. Eickwort, R. G. Tucker) (MSU, NLM). *Gila Co.*, ♀, Globe, VIII–9–1933 (Parker, 33) (CAS); ♀, Wheatfields, near Globe, August (D. K. Duncan) (AMNH). *Pima Co.*, ♂, Ajo Mts., X–17–1935, 2600 feet (O. Bryant) (CAS); ♂, Apache Camp, Santa Catalina Mts., VIII–25–1917, 5500 feet (MCZ); ♂, Baboquivari Canyon, W side Baboquivari Mts., VII–25–27–1952 (H. B. Leech and J. W. Green) (CAS); ♀, Esterero Canyon, Santa Catalina Mts., VI–19–1959 (Radford, Patterson, and Samuelson) (ARIZ); ♀, Greaterville, X–9–1954 (F. G. Werner) (*Baccharis*) (ARIZ); ♂, Kits Peak, VIII–1–4–1916 (Rincon) (AMNH); ♂, Sabino Canyon, VII–20–1917 (CNLL); ♂, Sabino Canyon, Santa Catalina Mts., VIII–23 (J. Bequaert) (MCZ); 4♂, Santa Rita Mts., VIII–18–1935 (Jean Russell, Jack Beamer) (KANS, NLM); ♂, Santa Rita Mts., VII–17–1932 (J. D. Beamer) (KANS); ♂, Santa Rita Mts., VII–19–1935 (Jean Russell) (KANS); ♀, Tucson, VII–5–1960 (F. Werner) (ARIZ). *Santa Cruz Co.*, ♀, Carr Canyon, VIII–8–1962 (S. L. Wood and J. B. Karren) (KANS); Garces, VIII (Biedermann). 3 ♂, 2 ♀, Palmerlee, July, August (N. Banks collection) (UCAL, MCZ).

New Mexico: *Hidalgo Co.*, ♂, Rodeo, IX–17–1958 (P. D. Hurd) (reared from *Xylocopa californica ariz-*

onensis Cr.) (UCAL); ♂, 1.5 mi. S Rodeo, IX–15–1958 (P. D. Hurd) (reared from *Xylocopa californica arizonensis* Cr.) (NLM); ♂, ♀, 7 mi. SE Rodeo, VIII–21–1958 (J. M. Marston, C. G. Moore) (UCAL, NLM); ♂, 18 mi. N Rodeo, VIII–25–1958 (P. M. Marsch) (UCAL).

Texas: *San Saba Co.*, ♀, Mouth of Brady Creek, VII–23–1931 (RHP). *Brewster Co.*, ♂, Lajitas, IX–6–1960 (J. E. Gillaspy) (CAS).

Biology.—According to Hurd (1959), *xylocopae* has been reared from nests of *Xylocopa californica arizonensis* Cresson at a locality 1.5 miles south of Rodeo, Hidalgo Co., N. Mex., and 40 miles southeast of Nuevas Casas Grandes, Chihuahua, Mexico. The bee nests in dead-flower stalks of *Yucca* and related plants.

Discussion.—*Anthrax xylocopae* may be distinguished from *tigrinus* by the black hairs anterodorsally on the first abdominal tergum. It differs from *delila* by the spot at the base of cell $3M_2$ being broadly connected along vein Cu_1 with the spot at the base of cell $2M_2$ (Plate 6*m*). *Anthrax simson* differs from *xylocopae* by having the wing pigment light brown and the veins yellowish brown and distinctly lighter than the pigment. The scales on the abdominal sterna are largely white in males of *simson*, whereas males of *xylocopae* have broad areas of black scales.

Anthrax xylocopae and *simson habrosus* have been taken together in several localities in central Arizona. It seems, however, that *s. habrosus* prefers drier habitats, although their habitats probably broadly overlap at edges of desert valleys. Besides characters given, *s. habrosus* differs from *xylocopae* by having a complete sectoral crossvein in most specimens. The few specimens of *s. habrosus* in which the sectoral crossvein is incomplete have the spur at the base of cell R_4 at least twice as long as the r–m crossvein, whereas in *xylocopae* it is seldom more than 2.0 times as long. The relationship between *xylocopae* and *tigrinus* is discussed under the latter.

Anthrax tigrinus (DeGeer)

Nemotelus tigrinus DeGeer, 1776, p. 206.

Argyramoeba tigrina.—Kertész, 1909, p. 67 [part].—Rau, 1926, p. 231.

Anthrax tigrinus.—Painter and Painter, 1965, p. 432 [part].

Anthrax scripta Say, 1823, p. 43; 1869, p. 59.

Anthrax simson.—Wiedemann, 1828, p. 259.—Macquart, 1840, p. 59.—Walker, 1849, p. 251.—Osten Sacken, 1858, p. 41 [part].—Johnson, 1925, p. 108.—Curran, 1927, p. 85.—Brimley, 1938, p. 341.—Hurd, 1959, p. 56 [not Fabricius, 1805; misidentification].

Argyramoeba simson.—Osten Sacken, 1877, p. 241.—Osten Sacken, 1878, p. 90 [part].—Coquillett, 1894, p. 95.—Johnson, 1895, p. 325 [not Fabricius, 1805; misidentification].

Spongostylum simson.—Aldrich, 1905, p. 223 [part] [*Spogostylum*].—Johnson, 1913, p. 55 [*Spogostylum*].—Malloch, 1917, p. 393 [*Spogostylum*].—Cole, Malloch, and McAtee, 1924, p. 186 [*Spogostylum*] [not Fabricius, 1895; misidentification].

Male.—Setae on front and face black, or setae on lower half of front and face partly or entirely reddish brown. Scales on upper part of front black, on lower half mixed gold and yellowish white, often some black scales present; scales on face mixed white and yellowish white, often some black scales present. Setae on occiput reddish brown, some longer black ones at vertex; scales gold or brown; fringe of pile on posterior margin light or dark brown basally, white or light brown apically, lighter below.

Setae on mesonotum black; black scales intermixed with lighter ones along meson. Disc of scutellum with spot of gold scales anteromedially (sometimes reduced). Setae on sternopleuron, mesopleuron, and anterior part of pteropleuron black, or with some reddish-brown setae intermixed above; scales on sternopleuron and pteropleuron white, brown or mixed, on mesopleuron black anteriorly, brown or white posteriorly; upper margin of mesopleuron with white pile. Pile on prosternum and propleuron black, reddish brown or mixed. Setae and scales on coxae black.

Wing pigmented as in Plate 6*n*. Pigment dark brown; veins dark reddish brown, not contrasting with pigment. Pigment at base of cell $3M_2$ broadly connected to spot at base of cell 2M along vein Cu_1, and usually connected along m crossvein to spot at base of cell M_1. Spots at apices of veins M_2 and Cu_1 broadly connected to spots at bases of cells M_1 and $3M_2$. Spur at basal angle of vein R_4 not connected to vein R_{2+3}, usually less than 2.0 times longer than r–m crossvein.

Lateral margins of first abdominal tergum with black or reddish brown pile ventrally and white pile dorsally, sometimes with some white hairs posteroventrally, but without black hairs anterodorsally. Dark scales on terga mostly black, some light-brown scales usually intermixed along posterior margin and medially on second tergum. Setae on dorsum black on discs, reddish along margins. Setae on venter reddish brown; scales black on discs, white and yellow posterolaterally and along posterior margins, light scales more numerous posteriorly.

MALE GENITALIA.—See group description and Figure 127.

FEMALE.—Setae on head mostly or entirely black. Light scales on mesonotum and pleura reduced in number or entirely absent. Spot of brown scales anteriorly on scutellum absent. Setae on abdomen black (rarely some reddish setae on venter); white scales on venter restricted to posterior sterna and lateral margins of first sternum.

FEMALE GENITALIA.—Similar to *simson habrosus* (Figure 121). Ninth tergum with about 32 spines on each side. Ducts of spermathecae with middle sections sclerotized; bulbs of spermathecae obovate in outline, about twice as long as maximum diameter and broadest medially.

DISTRIBUTION AND ECOLOGY.—*Anthrax tigrinus* may be found in forested areas from extreme southeast Canada throughout eastern United States to central Texas (Map 27). The distribution appears to be limited on the north by coniferous forests and on the west by the Great Plains. In western Texas *tigrinus* seems to be replaced by *xylocopae,* the latter being adapted to areas of grassland with xerophytic shrubs.

TYPES.—The two cotypes of *Nemotelus tigrinus* DeGeer are in the Naturhistoriska Riksmuseet, Entomologiska Avdelningen, Stockholm, Sweden. Dr. Karl-Johan Hedqvist (personal communication) has compared a photograph of the wing of a species of the *tigrinus* group with the type and found them closely similar· He also stated that the pile on the lateral margin of the first abdominal tergum is white above and black below, a characteristic of *tigrinus*. Neither specimen carries any label. The type-locality is Pennsylvania.

The type of *Anthrax scripta* Say has apparently been destroyed with the remainder of Say's collection. The excellent description leaves no doubt that the specimen is a member of the *tigrinus* group, and since the type-locality is Pennsylvania, it is a synonym of *tigrinus*.

BIOLOGY.—*Anthrax tigrinus* has been recorded as a parasite of *Xylocopa virginica* by Angus (1868) and Rau (1926). Hurd (1959) gives an excellent review of the information they compiled, as well as information on the biology of other species in the *tigrinus* group.

DISCUSSION.—*Anthrax tigrinus* is characterized by having the pile laterally on the first abdominal tergum black below (sometimes a few light hairs posteriorly) and entirely white above. In most specimens of other species, dark pile occupies the anteroventral part of the margins with few or many dark hairs anteriorly on the dorsal part. In a few specimens of other species, particularly *delila,* the pile laterally on the first tergum is largely or entirely white or yellowish, but there are no dark hairs dorsally.

Anthrax tigrinus is most similar to *xylocopae* and the two seem to have been relatively recently derived from a single population. The two species apparently now have different ecological preferences, however, *xylocopae* parasitizing carpenter bees nesting in flower stalks of *Yucca* and related plants, *tigrinus* parasitizing bees utilizing hardwood billets and structural beams for nesting sites. *Anthrax xylocopae* may have become adapted to a drier climate during the preceding interglacial period when forests retreated from between central Texas and southeast Arizona. Further collecting may show hybridization between the two populations, although, with their apparent ecological isolation, that seems unlikely.

Anthrax simson simson Fabricius

Anthrax simson Fabricius, 1805, p. 19—Osten Sacken, 1858, p. 41 [part].—Hurd, 1959, p. 58 [part].

Argyramoeba simson.—Osten Sacken, 1878, p. 90 [part].—Osten Sacken, 1886, p. 100.

Spongostylum simson.—Aldrich, 1905, p. 223 [part] [*Spogostylum*].

Argyramoeba tigrina.—Kertész, 1909, p. 67 [part] [not DeGeer, 1776].

Anthrax tigrinus.—Painter and Painter, 1965, p. 432 [part] [not DeGeer, 1776].

MALE.—Setae on front and face reddish brown and black; scales on front black above, mixed black and yellowish white below; scales on face gold and yellowish white; setae on genae black. Fringe of pile on posterior margin of occiput brown or yellow basally, white apically.

Setae on mesonotum black or partly reddish brown; area of light scales more extensive than area of black scales. Scutellum often with some gold scales anteromedially. Setae on mesopleuron, sternopleuron, and anterior part of pteropleuron reddish brown and black; scales mixed gold and white, some black scales above on mesopleuron; upper part of mesopleuron with white pile above and black pile below. Pile on prosternum and propleuron light or dark brown. Setae on coxae black or partly reddish brown; scales gold, some white scales on anterior pair.

Wing pigmented as in Plate 6*k*. Pigment dark brown, veins light brown and contrasting with pig-

ment. Pigment at base of cell $3M_2$ broadly connected with spot at base of cell $2M_2$ along vein Cu_1, usually separated from pigment at base of cell M_1 on m crossvein. Spots at apices of cells M_2 and Cu_1 broadly connected to spots at bases of cells M_1 and $3M_2$. Spur at base of cell R_4 not connected to vein R_{2+3} to form sectoral crossvein, less than 2.0 times as long as r–m crossvein.

Abdominal terga with reddish-brown setae along margins, black setae anteriorly. Pile on lateral margins of first tergum light reddish brown to reddish black on anteroventral half to three-fourths, some white hairs below in lighter specimens. Setae on venter reddish brown; scales white laterally and along posterior margins, dark brown anteromedially.

MALE GENITALIA.—See group description and Figure 127.

FEMALE.—Setae on face, front, thorax, and abdomen black. Pile on prosternum and propleuron black; scales on mesopleuron mostly black. Dark pile on first abdominal tergum black; white scales less extensive on sterna.

FEMALE GENITALIA.—Similar to *simson habrosus* (Figure 121).

DISTRIBUTION AND ECOLOGY.—The few specimens available indicate that *simson simson* occurs along the east coast of Mexico from southern Tamaulipas southward throughout Central America, and along the Caribbean coast to Venezuela (Map 27). It may also occur southward into eastern and southern Brazil, although no specimens have been seen from there.

In southeastern Mexico *s. simson* is apparently allopatric to *s. habrosus,* although few specimens are available from that area. They may occur together in Chiapas and eastern Oaxaca, although *s. simson* probably is largely restricted to wetter habitats along the Atlantic side, whereas *s. habrosus* occurs in the drier Pacific side.

TYPE.—According to Painter and Painter (personal notes) the type male of *Anthrax simson* Fabricius is in the Universitets Zoologiske Museum in Copenhagen. It carries the red type label and another label "A. *simson* ex Am. Mer. Schmidt." The antennae are missing and the specimen is dirty and somewhat greasy. A photograph of the type indicates that it is the species described here. Fabricius gave the type-locality as "Habitat in America Meridionali."

BIOLOGY.—The only reference to the biology of *s. simson* is that of Hurd (1959, p. 58):

> Many cells of this species [*Xylocopa augusti* Lepeletier] located on January 13, 1956, in a hardwood fence post at Araucaria, Paraná, Brasil, were found by Dr. C. D. Michener and Padre J. S. Moure to contain larvae and pupae of an undetermined bombyliid (Hurd, 1958). This is the first record of beefly parasitism of a South American *Xylocopa*. Since *Anthrax simson* is known to occur in the vicinity where the nest was located, it quite possibly may have been the species involved.

Since no specimens have been seen from south of Venezuela, validity of this record cannot be verified.

DISCUSSION.—One specimen of *s. simson,* from Tamazunchale, San Luis Potosí, Mexico, lacks the crossvein between the m crossvein and vein Cu_1 which is characteristic of species of the *tigrinus* group.

Anthrax simson simson differs from *delila, xylocopae,* and *tigrinus* by having the veins of the wing light reddish brown, contrasting with the surrounding pigment, rather than dark brown or red and not contrasting. The pigment also is distinctly lighter in *s. simson.* The relationship of *s. simson* to *s. habrosus* is discussed under the latter.

Anthrax simson habrosus, new subspecies

Argyramoeba simson.—Williston, 1901, p. 275 [not Fabricius, 1805; misidentification].

Spongostylum simson.—Aldrich, 1905, p. 223 [part] [*Spogostylum*] [not Fabricius, 1805; misidentification].

Argyramoeba tigrina.—Kertész, 1909, p. 67 [part] [not DeGeer, 1776, misidentification].

Anthrax tigrinus.—Painter and Painter, 1965, p. 432 [part] [not DeGeer, 1776, misidentification].

MALE.—Setae on face and front reddish brown. Scales on front mostly yellowish white and tan, darker above; scales on face yellowish white and tan. Setae and scales on genae tan. Fringe of pile on posterior margin of occiput yellowish brown basally, white apically.

Setae on mesonotum reddish brown. Scutellum with large anteromedial patch of gold scales. Gold and white scales more extensive than black scales on mesonotum. Pile on prosternum and propleuron light brown. Setae on mesopleuron, sternopleuron, and anterior part of pteropleuron light reddish brown; scales white, upper part of mesopleuron with dense white pile. Coxae with dark reddish-brown setae and gold scales.

Wing pigmented as in Plate 6*l*. Pigment brown, veins light brown, contrasting. Spur at base of cell R_4 connected to vein R_{2+3} to form complete sectoral crossvein. Spot at base of cell $3M_2$ broadly connected along vein Cu_1 to spot at base of cell $2M_2$, but not connected to spot at base of cell M_1.

Pile on lateral margins of first abdominal tergum reddish brown posteroventrally to black anterodorsally on anteroventral nine-tenths. Dark setae on terga reddish brown; few light brown scales intermixed with black scales. Setae on venter reddish brown. Scales light brown basally and white apically on proximal segments, entirely white on distal segments.

MALE GENITALIA.—See generic description and Figure 127.

FEMALE.—Similar to male. Setae on front mostly black; some black setae intermixed on face. Setae on mesonotum, thoracic pleura, and coxae black. Pile on prosternum and propleuron dark reddish brown and black. Scales on mesopleuron, sternopleuron, and an-

MAP 27.—Distribution of *Anthrax tigrinus* (triangles and vertical lines), *simson simson* (squares and diagonal lines), and *A. simson habrosus* (circles and horizontal lines).

terior part of pteropleuron mixed gold and white. Dark pile on lateral margins of first abdominal tergum black; setae black on anterior parts of terga. Setae on venter dark reddish brown; scales mostly black, some white scales laterally along posterior margins of sterna.

FEMALE GENITALIA (Figure 121).—Ninth tergum with about 22 spines on each side. Middle sections of ducts of spermathecae lightly sclerotized, slightly darker than other sections; smaller bulbs slightly asymmetrical, obovate in outline, about 2.0 times longer than maximum diameter, larger bulb only slightly broader than smaller ones.

VARIATION.—Males may have numerous black setae intermixed with reddish brown ones on the front, mesonotum, and abdomen. The setae on the pleura may be partly or entirely black and there may be numerous black scales, especially on the mesopleuron. The pile on the prosternum and propleuron varies from light brown to black. The dark pile on the lateral margins of the first abdominal tergum varies from light tan to black, being darker on females. Gold or brown scales may be absent on the scutellum and abdominal terga. The white scales on the abdominal sterna may be less extensive in both sexes. The sectoral crossvein on the wings is incomplete in some specimens, in which case the spur at the base of cell R_4 is about twice as long as the r–m crossvein. The pigmented area at the base of cell $3M_2$ often is connected to that at the base of cell M_1.

DISTRIBUTION AND ECOLOGY.—*Anthrax simson habrosus* occurs in desert and semidesert areas from Arizona, southern California, and Baja California south along the Pacific coast to Chiapas, Mexico, and possibly into western Guatemala (Map 27). It is allopatric to *delila* in southern California. Although the two have been collected together at several localities, *A. s. habrosus* and *A. xylocopae* are generally allopatric in east-central Arizona. In southeastern Mexico, *s. habrosus* appears to be allopatric to *s. simson*, the former occupying drier areas on the Pacific side; the latter, wetter areas on the Atlantic side.

HOLOTYPE—♂, Tucson, Pima Co., Arizona, VI–17–1954 (R. S. Beal) (A taken in copulation with specimen "B") (UCAL).

ALLOTYPE.—♀, Tucson, Pima Co., Arizona, VI–17–1954 (R. S. Beal) (B taken in copulation with specimen "A") (UCAL).

PARATYPES.—Arizona: *Coconino Co.*, 2♂, Bright Angel Trail, Grand Canyon, VIII–4–1917 (E. C. Shannon) (Cornell U. Lot 869, Sub. 2) (CNLL, RHP); ♂, Oak Creek Canyon, VIII–4–1961, 3500 feet (G. C. Eickwort) (MSU); ♂, 15 mi. N Sedona, IX–14–16–1955 (G. D. Butler) (ARIZ). *Gila Co.*, ♀, Capitan Mt., VIII–3–1933 (R. Anderson) (CAS); ♀, Globe (D. K. Duncan) (AMNH); ♂, Midland Pioneer Camp, Pinal Mts., VIII–16–1950, 5000–6100 feet (T. Cohn, P. Boone, and M. Cazier) (AMNH); ♂, base of Pinal Mts., August (D. K. Duncan) (AMNH); ♂, Roosevelt, VIII–22–1933 (Parker) (CAS); ♀, Tonto National Mon., VIII–26–1932 (R. H. Painter) (RHP); ♂, Wheatfields, near Globe (D. K. Duncan) (AMNH). *Maricopa Co.*, ♂, Phoenix, 1934 (R. J. Crandell) (AMNH). *Pima Co.*, ♀, Arivaca, VII–17–1934 (L. P. Wehrle) (ARIZ); ♂, Baboquivari Mts., VII–19–1932 (R. H. Beamer) (KANS); ♀, Esterero Canyon, Santa Catalina Mts., VI–19–1959 (Radford, Patterson and Samuelson) (ARIZ); 2♂, VII–15, IX–30–1939 (Bryant) (CAS, NLM); ♂, Tucson (F. H. Snow) (C. H. Curran collection, Acc. 31144) (AMNH); ♀, Tucson, VII–5–1946 (R. H. Crandall) (NLM); ♂, Tucson, VI–11–1961 (F. Werner) (ARIZ); ♀, 18 mi. NE Tucson, VI–14–1961, 2900 feet (R. H. and E. M. Painter) (RHP). *Santa Cruz Co.*, 2♀, Patagonia, VIII–6–1958 (C. W. O'Brien) (Linsdale). *Yuma Co.* ♂, Yuma, IX–11–1959 (D. Mose) (ARIZ).

California: *Los Angeles Co.*, ♀, Downey, VII–8–1940 (M. M. Barnes) (CAS). *Orange Co.*, ♂, Brea, VIII–26–1923 (A. J. Basinger) (UCAL); ♀, Newport Bay, VI–31–1940 (P. D. Hurd) (UCAL). *Riverside Co.*, 2♂, Riverside, VIII–17, IX–1–1947 (T. E. Leigh) (UCAL); ♂, Riverside, VII–19–1936 (G. P. Englehardt) (RHP); ♂, Riverside, VIII–27–1962 (H. E. Evans) (RHP); ♂, Riverside, August (A. L. Melander) (USNM). *San Bernardino Co.*, 2♂, Redlands, IX–13 (UCAL, NLM).

Mexico: *Baja California Sur.*, ♂, Cerralbo Island, Gulf Calif., VI–5–1921 (E. P. VanDuzee) (CAS); ♂, Las Animas, Sierra Laguna, X–12–1941 (Ross and Bohart) (CAS); 2 ♀, La Paz, VI–3–1921 (E. P. Van Duzee) (CAS, NLM); ♂, 5 mi. S Miraflores, VII–10–1938 (Michelbacher and Ross) (CAS); ♂, 5 mi. W San Bartolo, VII–13–1938 (Michelbacher and Ross) (CAS); ♀, 3 mi. N San Pedro, VII–6–1938 (Michelbacher and Ross). *Chiapas*, ♂, 4 mi. SE Soyalo, III–15–1953 (R. C. Bechtell, E. I. Schlinger) (UCAL). *Durango*, ♀, El Saldado, VI–22–1961, 7600 feet (R. A. Scheibner) (MSU). *Guerrero*, ♂, between

Cajones and Rincon, S of Chilpancingo, VII–1–1932 (H. Smith) (RHP); ♂, 25 mi. S Iguala, IX–14–1963, 2400 feet (R. H. and E. M. Painter) (RHP). *Michoacán,* ♂, Apatzingán, VII–21–1947 (T. H. Hubbell) (MU). *Morelos,* ♂, 3 mi. N Alpuyeca, IV–18–1959, 3400 feet (H. E. Evans) (RHP); ♂, Canyon de Lobos, Yautepec, IV–13–1959, 4000 feet (H. E. Evans) (RHP); ♂, Cuernavaca (R. Muller) (USNM); ♂, Cuernavaca, III–10–1959, 5500 feet (H. E. Evans) (RHP); ♂, Huajintlan, IV–11–1959, 2800 feet (H. E. Evans) (NLM). *Nayarit,* ♂, nr. Compostela, V–7–VIII–17–1937 (E. Rosenbauer) (RHP). *Oaxaca,* ♂, 4 mi. S Tehauntepec, VII–18–1952 (E. E. Gilbert and C. D. MacNeil) (UCAL); ♂, 14 mi. NW Tehauntepec, VI–26–1961, 700 feet (U. Kans. Exped.) (KANS); ♂, Tequistlan, IV–8–1953 (R. C. Bechtel and E. I. Schlinger) (UCAL). *Sinaloa,* ♂, 40 mi. S Culiacan, VII–22–1954 (M. Cazier, W. Gertsch and Bradts) (AMNH). *Sonora,* ♂, 10 mi. E Navajoa, VIII–13–1959 (W. L. Nutting and F. G. Werner) (ARIZ); ♀, San Bernardo, VIII–25–1935 (CAS).

Biology.—No reared specimen of *s. habrosus* has been seen and the literature contains no records of the biology.

Discussion.—*Anthrax simson habrosus* is similar in all respects to *s. simson,* except the former usually has a complete sectoral crossvein. In view of their occupying ecologically different habitats, however, and because their distributions do not overlap appreciably, they are regarded here as distinct subspecies. They probably were isolated by cold uplands in southeastern Mexico during the last glacial period, *s. simson* being restricted to the Gulf coast of Mexico and Central America and *s. habrosus* occurring in warmer Pacific side areas in south-central and western Mexico.

The subspecies *A. s. habrosus* may be readily distinguished from both *delila* and *xylocopae* by the complete sectoral crossvein on the wing. In the few specimens of *s. habrosus* with the sectoral crossvein incomplete, the spur at the base of cell R_4 is usually at least twice as long as the r–m crossvein, whereas it is rarely more than 2.0 times longer in *delila* and *xylocopae*. Also, the veins of the wing are light brown, contrasting with the pigment, in *s. habrosus,* whereas they are the same color as the pigment or darker in *xylocopae* and *delila*.

Literature Cited

Aldrich, J. M.
1905. A Catalogue of North American Diptera (or Two-Winged Flies). *Smithsonian Miscellaneous Collections,* 46(2):1–680.

d'Andretta, M. A. V., and M. Carrera.
1952. Resultados de uma expedicão cientifica ao Território do Acre. Diptera. *Papéis Avulsos do Departamento de Zoología Secretaria da Agricultura, São Paulo,* 10:293–305.

Angus, J.
1868. Habits of Carpenter Bees. *American Naturalist,* 1:157.

Baker, C. F.
1895. Biological Notes on Some Colorado Diptera. *Entomological News,* 6:173–174.

Bezzi, M.
1924. *The Bombyliidae of the Ethiopian Region.* 390 pages, 46 figures. London: British Museum (Natural History).

Bigot, J. M. F.
1892. Diptères nouveaux ou peu connus. 37e partie, 46: Bombyliid (mihi). *Annales de la Société Entomologique de France,* 61:321–376.

Blanchard, E.
1852. Orden IX. Dipteros. In C. Gay, ed., *Historia fisica y politica de Chile, Zoologia,* 7:327–468, Paris.

Brimley, C. S.
1938. *The Insects of North Carolina.* 560 pages. Department of Agriculture, Raleigh.

Brooks, A. R.
1952. Identification of Bombyliid Parasites and Hyperparasites of Phalaenidae of the Prairie Provinces of Canada, with Descriptions of Six Other Bombyliid Pupae (Diptera). *Canadian Entomologist,* 84:357–373, 46 figures.

Chaney, R. W.
1940. Tertiary Forests and Continental History. *Bulletin of the Geological Society of America,* 51:469–488.

Cockerell, T. D. A.
1914. Fossil and Recent Bombyliidae Compared. *Bulletin of the American Museum of Natural History,* 33: 229–236, 20 figures.

Cole, F. R.
1957. New Bombyliid Flies from Chiapas, Mexico (Diptera). *Pan-Pacific Entomologist,* 33:200–202. 1 figure.

Cole, F. R., and A. L. Lovett
1919. New Oregon Diptera. *Proceedings of the California Academy of Sciences,* ser. 4, 9:221–255, 6 plates.
1921. An Annotated List of the Diptera (Flies) of Oregon. *Proceedings of the California Academy of Sciences,* ser. 4, 11:197–344, 54 figures.

Cole, F. R., J. R. Malloch, and W. L. McAtee
1924. District of Columbia Diptera: Tromoptera (Cyrtidae, Bombyliidae, Therevidae, Scenopinidae), *Proceedings of the Entomological Society of Washington,* 26:181–195.

Coquillett, D. W.
1894. Notes and Descriptions of North American Bombyliidae. *Transactions of the American Entomological Society,* 21:89–112.

Curran, C. H.
1927. Descriptions of Nearctic Diptera. *Canadian Entomologist,* 59:79–92, 5 figures.
1934. The Diptera of Kartabo, Bartica District, British Guiana, with Descriptions of New Species from Other British Guiana Localities. *Bulletin of the American Museum of Natural History,* 66:287–532, 54 figures.

Davidson, A.
1893. The Nest and Parasites of *Xylocopa orpifex* Smith. *Entomological News and Proceedings of the Entomological Section of the Academy of Natural Sciences of Philadelphia,* 4:151–153.
1894. On the Parasites of Wild Bees in California. *Entomological News and Proceedings of the Entomological Section of the Academy of Natural Sciences of Philadelphia,* 5:170–172.

DeGeer, C.
1776. *Mémoires pour servir à l'histoire des Insects.* 6:1–523, 30 plates. Stockholm.

Dunbar, C. C.
1949. *Historical Geology.* 573 pages. London.

Edwards, F. W.
1930. *Diptera of Patagonia and South Chile. Bombyliidae.* 5(2):162–179. London: British Museum (Natural History).

Fabricius, J. C.
1805. *Systema antliatorum secundum ordines, genera, species.* 373+30 pages. Brunswick.

Hall, J. C.
1954. Notes on the Biologies of Three Species of Bombyliidae, with a Description of One New Species. *Entomological News,* 65:145–149.

Hopkins, D. M.
1959. Cenozoic History of the Bering Land Bridge. *Science,* 129:1519–1528.

Hubbell, T. H.
1954. Relationships and Distribution of *Mycotrupes.* In Olson, Hubbell, and Howden, The Burrowing Beetles in the Genus *Mycotrupes* (Coleoptera: Scarabaeidae: Geotrupinae). *Michigan University Museum of Zoology Miscellaneous Publication,* 84:1–73.

Hurd, P. D., Jr.
1959. Beefly Parasitism of the American Carpenter Bees Belonging to the Genus *Xylocopa* Latreille (Diptera: Hymenoptera). *Journal of the Kansas Entomological Society,* 32:53–58.

Johnson, C. W.
1895. Diptera of Florida. *Proceedings of the Academy of Natural Sciences of Philadelphia,* 1895:303–340.
1913. Insects of Florida: I. Diptera. *Bulletin of the American Museum of Natural History,* 32:37–90.
1925. Fauna of New England. 15. List of the Diptera or Two-Winged Flies. *Occasional Papers of the Boston Society of Natural History.* 7(15):1–326, 1 figure.

Kertész, C.
1909. *Catalogus Dipterorum hucusque descriptorum.* 5:1–199. Leipzig, Budapest.

Krombein, Karl V.
1967. *Trap-Nesting Wasps and Bees: Life Histories, Nests, and Associates.* 570 pages. Washington: Smithsonian Institution Press.

Loew, H.
1869. Diptera Americae septentrionalis indigena. Centuria octava. *Berliner Entomologische Zeitschrift,* 13:1–52.
1872. *Diptera Americae septentrionalis indigena.* 2:1–300. [Centuriae 6–10]. Berlin.

Lynch Arribálzaga, F.
1879. Notas dipterologicas sobre los Anthracidos y Bombiliarios del Partido del Baradero (Provincia de Buenos Aires). Parte primera, Anthracidos. *El Naturalista Argentino,* 1:225–231, 263–275.

Macquart, J.
1834. Histoire naturelle des Insectes. Diptères. In N. E. Roret, ed., *Collection des suites à Buffon,* 1:1–578, 12 plates. Paris.
1840. *Diptères exotiques nouveaux ou peu connus.* 2(1):5–135, 2 plates. (Also published in *Mémoirs of the Société Royal des Sciencias, de l'Agricole et des Arts, Lille,* 1840:283–413, 21 plates. 1841).
1846. Diptères exotiques nouveaux ou peu connus. Supplement 1. *Mémoirs of the Société Royal des Sciencias de l'Agricole et des Arts, Lille* (1845), 1844:133–364, 20 plates. (Also published separately as his *Diptères exotiques nouveaux ou peu connus.* Supplement, 1:5–238, 20 plates. 1846. Paris.)
1848. Diptères exotiques nouveaux ou peu connus. Supplement 3, *Mémoirs of the Société Royal des Sciencias, de l'Agricole et des Arts, Lille,* 1847(2):161–237, 7 plates. (Also published separately as his *Diptères exotiques nouveaux ou peu connus.* Supplement, 3:1–77, 7 plates. 1848. Paris.)
1850. Diptères exotiques nouveaux ou peu connus. Supplement 4 (part), *Mémoirs Société Royal des Sciencias, de l'Agricole et des Arts, Lille,* 1849: 390–479, plates 1–14. (Also published separately as his *Diptères exotiques nouveaux on peu connus.* Supplement, 4 [part]: 311–317, 324–336, plates 1–14. 1850 [1851]. Paris.)
1885. Diptères exotiques nouveaux on peu connus. Supplement 5, *Mémoirs Société Royal des Sciencias, de l'Agricole et des Arts, Lille,* 1854:25–156, 7 plates. (Also published separately as his *Diptères exotiques nouveaux ou peu connus.* Supplement 5:5–136, 7 plates. 1855. Paris.)

Malloch, J. R.
1915. Some Additional Records of Chironomidea for Illinois and Notes on Other Illinois Diptera. *Bulletin of the Illinois State Laboratory of Natural History* (1918), 11:305–363, 5 plates.

1917. A Preliminary Classification of Diptera, Exclusive of Pupiara, Based upon Larval and Pupal Characters, with Keys to Imagines in Certain Families: Part 1. *Bulletin of the Illinois State Laboratory of Natural History* (1918), 12:161–409, plates 28–57.

Marston, N.

1963. A Revision of the Nearctic Species of the *albofasciatus* Group of the Genus *Anthrax* (Diptera: Bombyliidae). *Technical Bulletin of the Kansas Agricultural Experiment Station,* 127:1–79, 6 plates.

1964. The Biology of *Anthrax limatulus fur* (Osten Sacken), with a Key to and Descriptions of Pupae of Some Species in the *Anthrax albofasciatus* and *trimaculatus* Groups (Diptera: Bombyliidae). *Journal of the Kansas Entomological Society,* 37:89–105.

Martin, P. S.

1958. Pleistocene Ecology and Biogeography of North America. In C. L. Hubbs, ed., Zoogeography. *American Association for the Advance of Science,* 51:375–420.

Maughan, L.

1935. A Systematical and Morphological Study of Utah Bombyliidae, with Notes on Species from Intermountain States. *Journal of the Kansas Entomological Society,* 8:27–36, 37–80, 4 plates.

Mayr, E., E. G. Linsley, and R. L. Usinger

1953. *Methods and Principles of Systematic Zoology.* 328 pages+A–H. New York, Toronto, and London: McGraw-Hill.

Nininger, H. H.

1916. Studies in the Life Histories of Two Carpenter Bees of California, with Notes on Certain Parasites. *Journal of Entomology and Zoology,* 8:158–165, 2 plates.

Oldroyd, H.

1938. Bombyliidae from Chile and Western Argentina (Part II). *Revista Chilena de Historia Natural Pura y Aplicada,* 41:83–93. 1937.

Osten, Sacken, C. R.

1858. Catalog of the Described Diptera of North America. *Smithsonian Miscellaneous Collections,* 3(1):vii–xx, 1–92.

1877. Western Diptera: Descriptions of New Genera and Species of Diptera from the Region West of the Mississippi and Especially from California. *Bulletin of the U.S. Geology and Geography Survey of the Territories,* 3:189–354.

1878. Catalog of the Described Diptera of North America (Ed. 2), *Smithsonian Miscellaneous Collections,* 16 (2):1–276.

1886. Diptera. In Godman and Salvin, eds., *Biologia Centrali-Americana Zoologia-Insecta-Diptera,* 1:1–24, 25–48, 49–72, 73–104, 105–128, plates 1–2.

Painter, R. H.

1930. Notes on Some Bombyliidae (Diptera) from the Republic of Honduras. *Annals of the Entomological Society of America,* 23:793–807, 1 plate.

1933. Notes on Some Bombyliidae (Diptera) from Panama. *American Museum Novitates,* 642:1–10.

Painter, R. H., and E. M. Painter

1962. Notes on and Redescriptions of Types of North American Bombyliidae (Diptera) in European Museums. *Journal of the Kansas Entomological Society,* 35:2–164, 20 figures.

1965. Family Bombyliidae. In Stone et al., eds., *A Catalog of the Diptera of America North of Mexico,* pages 407–446. U.S. Department of Agriculture.

Paramonov, S. J.

1947. Dipterologische Fragmente. 37. Bombyliiden-Notizen. *Eos,* 23:79–101.

Philippi, R. A.

1865. Aufzählung der chilenischen Dipteren. *Verhandlungen der K.K. zoologischen-botanischen Gesellschaften in Wein,* 15:595–782, 7 plates.

Priddy, R. B.

1939. List of Bombyliidae Collected in Southern California and Yuma County, Arizona. *Journal of Entomology and Zoology,* 31:45–53.

Rau, P.

1926. The Ecology of a Sheltered Clay Bank: a Study in Insect Sociology. *Transactions of the Academy of Sciences of St. Louis,* 25:157–277, 8 plates.

1940. Some Mud-Daubing Wasps of Mexico and Their Parasites. *Annals of the Entomological Society of America,* 33:590–595.

Rondani, C.

1863. *Diptera exotica Revisa et Annotata.* 99 pages, 1 plate. Modena. (Also as "Dipterorum species et genera aliqua exotica," in *Archivio per Zoologia, l'Anatomia e la Fisiologia* [Modena, 1863], 3(1): 1–99, plate 5. 1864.

Sack, P.

1909. Die Palaerktischen Spongostylinen. *Abhandlungen Senckenbergtsche Naturforschende Gesellschaft,* 30:503–548. Frankfurt.

Say, T.

1823. Descriptions of Dipterous Insects of the United States. *Proceedings of the Academy of Natural Sciences of Philadelphia,* 3:9–54, 73–104.

1859. Descriptions of Dipterous Insects of the United States. In Leconte, J. L., ed., *The Complete Writings of Thomas Say on the Entomology of North America,* 2:38–66, 67–89. New York.

Schiner, J. S.

1868. Diptera. In Wullerstorf-Urbair, B. von (in charge), *Reise der Österreichischen Fregatte Novara. Zoology* 2(1):1–388, 4 plates. Wien.

Sears, P. B., and H. Clisby

1955. Palynology in Southern North America. Part IV: Pleistocene Climate in Mexico. *Bulletin of the Geological Society of America,* 66:521–530.

Shelford, V. E.

1913. The Life History of a Bee-Fly (*Spogostylum anale* Say), Parasite of the Larva of a Tiger Beetle (*Cicindella scutellaris* Say, var. *lecontei* Hald.). *Annals of the Entomological Society of America,* 6: 213–225.

Strickland, E. H.

1938. An Annotated List of the Diptera (Flies) of Alberta. *Canadian Journal of Research,* Sec. D. Zool. Sci., 16:175–219, 1 figure.

Stuardo Ortiz, C.

1946. *Catatogo de los Dipteros de Chile.* 250 pages. Santiago de Chile.

Townsend, C. H. T.

1893. The pupa of *Argyramoeba oedipus* Fabr. *American Naturalist,* 27:60–63.

Walker, F.

1849. *List of the Specimens of Dipterous Insects in the Collection of the British Museum.* 2:231–484. London: British Museum (Natural History).

1852. Diptera. In W. W. Saunders, ed., *Insecta Saundersiana,* 1(3):157–252; 1(4):253–414, 4 plates. London.

1857. Characters of Undescribed Diptera in the Collection of W. W. Saunders. *Transactions of the Entomological Society of London,* new series, 4:119–158.

Wiedemann, C. R. W.

1828. *Assereuropäische zweiflügelige Insekten.* 1:i–xxxii+1–608, 7 plates. Hamm.

Williston, S. W.

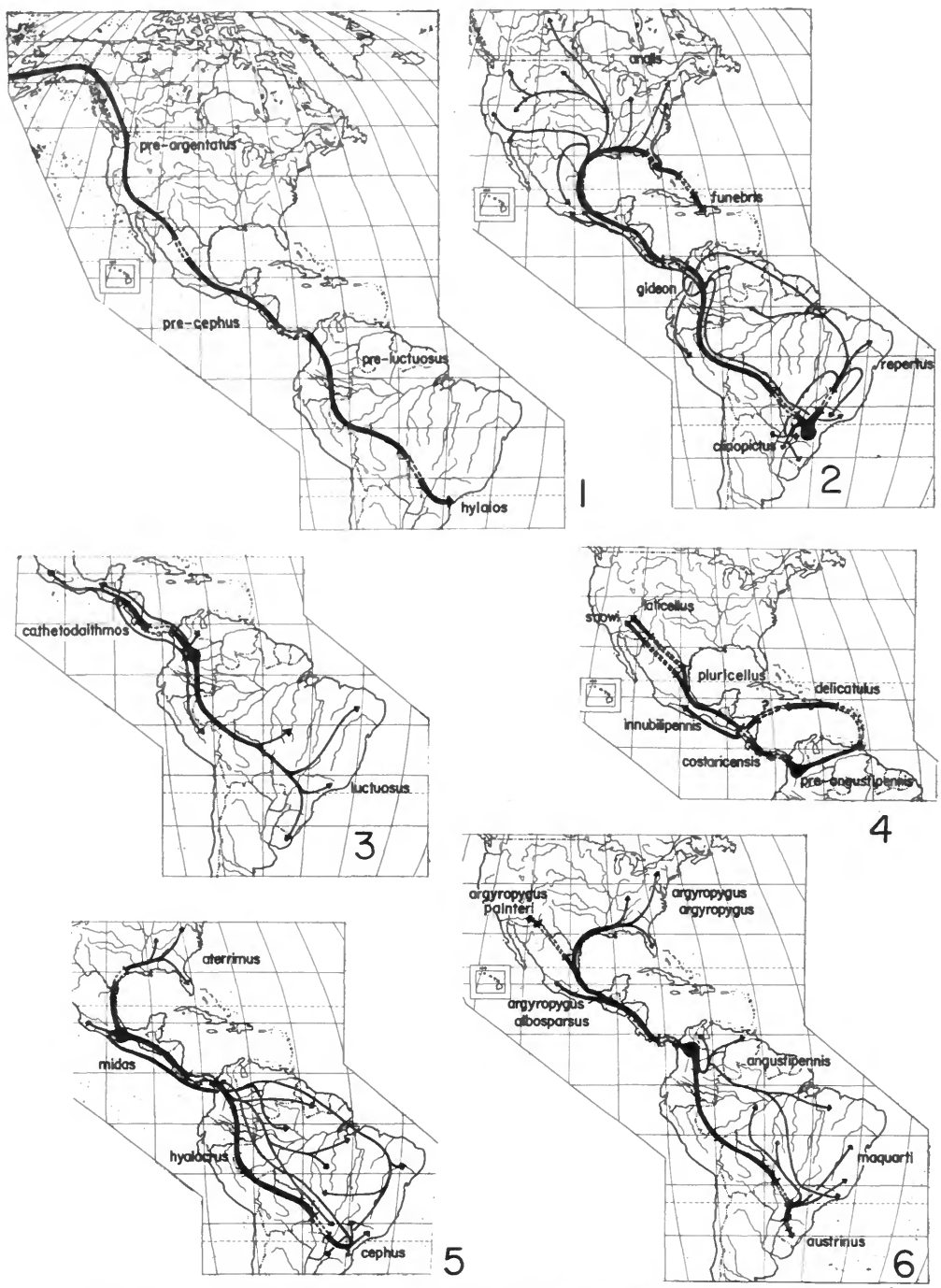
1900–1901. Diptera. In Godman and Salvin, eds., *Biologia Centrali-Americana.* Zoologia-Insecta-Diptera, Supplement (part). 1(1901):217–248, plates 4–5; 1(1901):249–264, 265–272, 273–296, 297–328, 329–332, plate 6: figures 1–6.

Wolcott, G. N.

1951. The Insects of Puerto Rico. Diptera. *Journal of Agriculture of the University of Puerto Rico* 32: 417–532. 1948.

Wulp, F. M. Van der.

1882. Amerikaansche Diptera. *Tijdschrift vor Entomologie* (1881–1882) 25:77–136, plates 9–10.



FIGURES 1–6.—Hypothetical origins, points of isolation, and routes of dispersal of the taxa of the *Anthrax cephus* group in North and South America: 1, ancestral form of *cephus* group; 2, *analis* complex; 3, *luctuosus* complex; 4, *argyropygus* complex, I; 5, *cephus* complex; 6, *argyropygus* complex, II.

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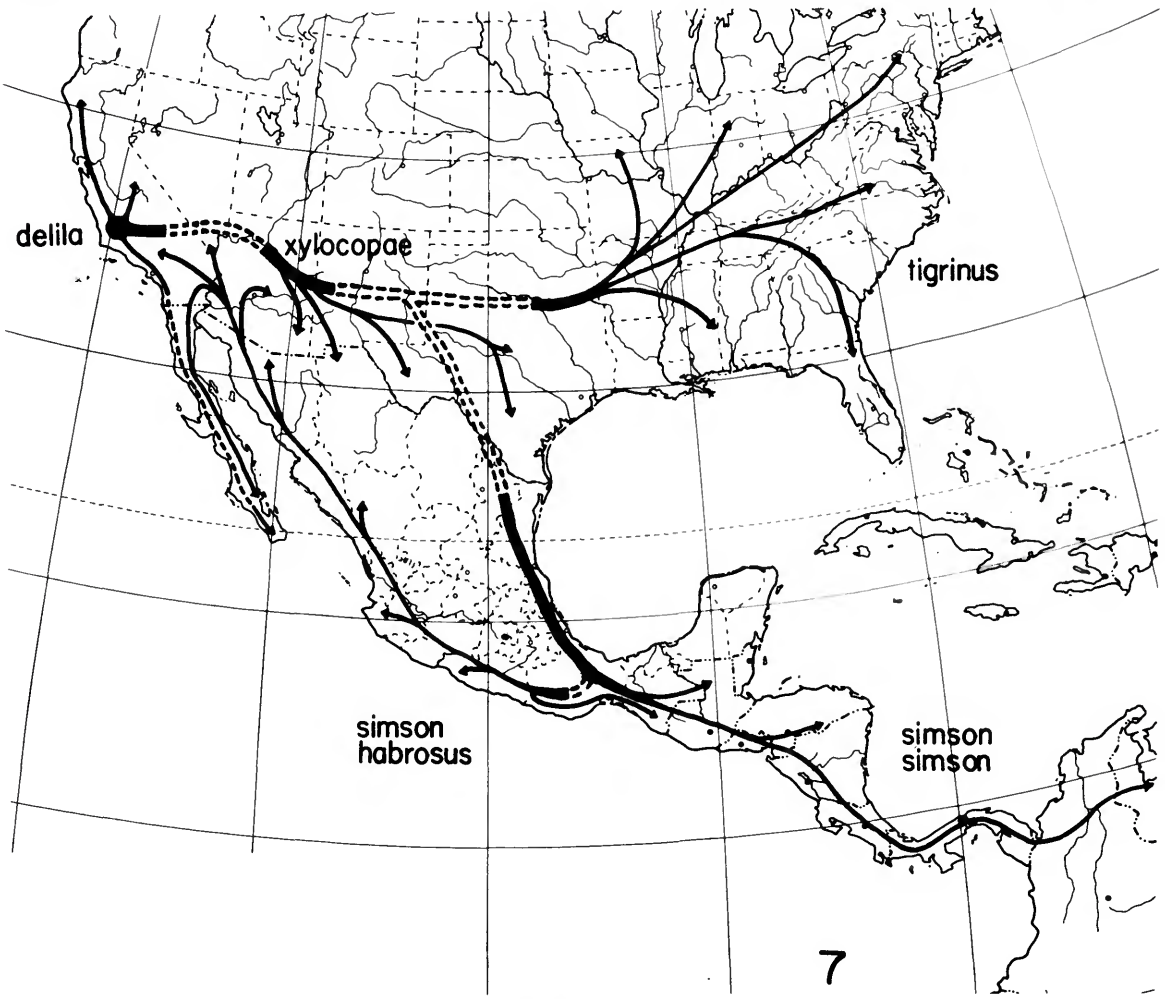
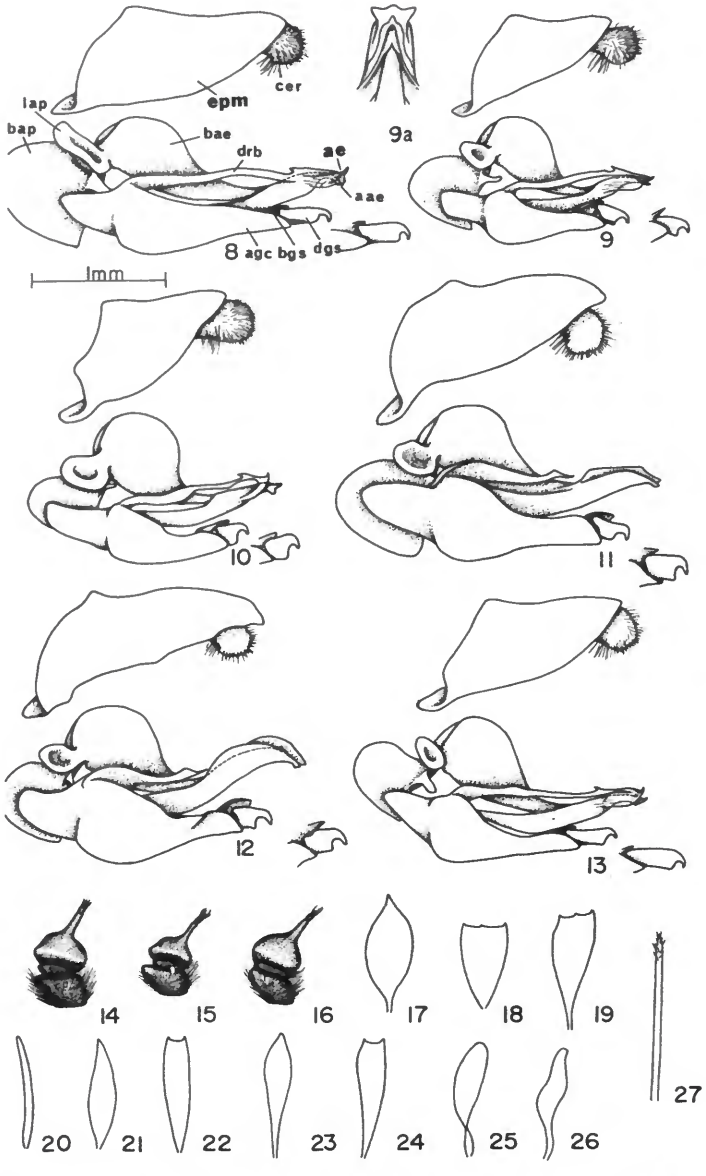
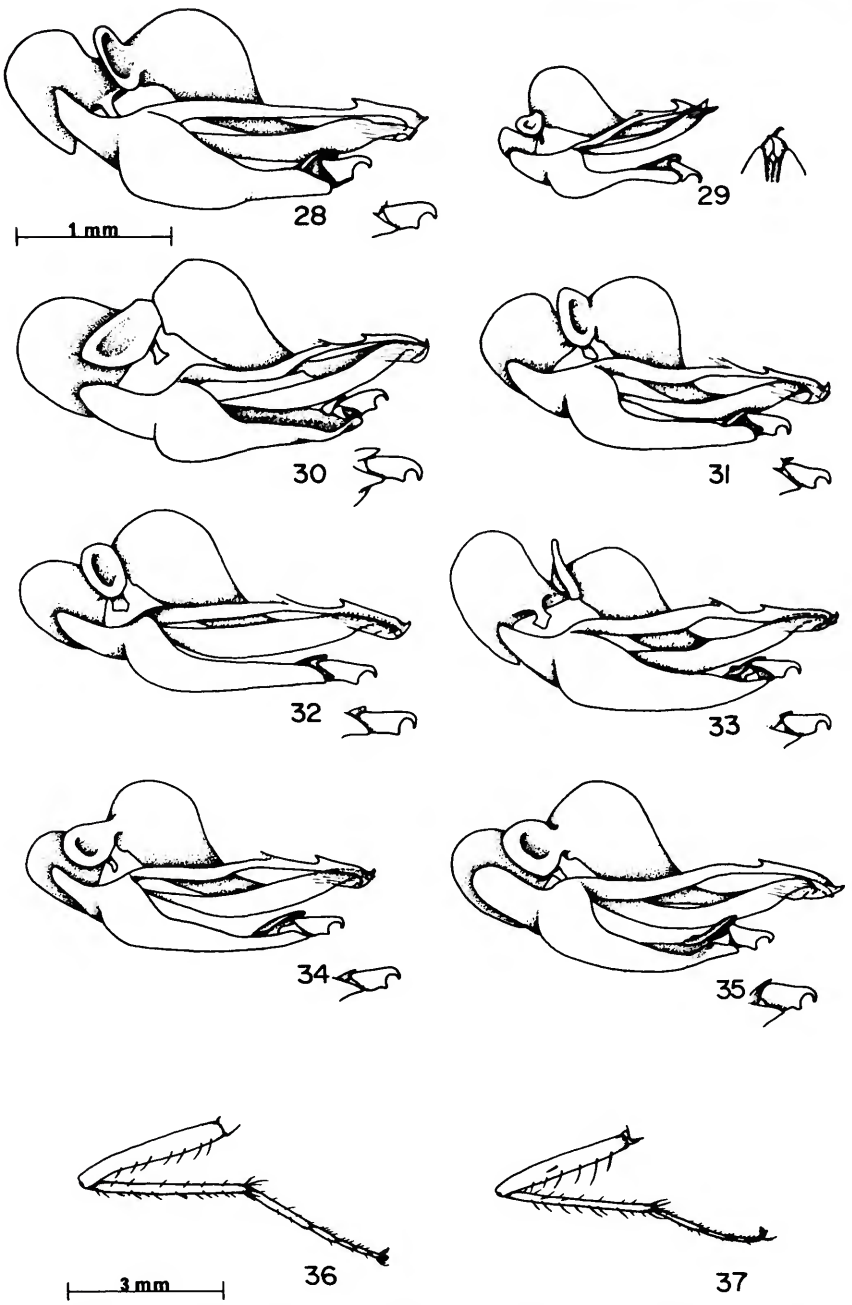


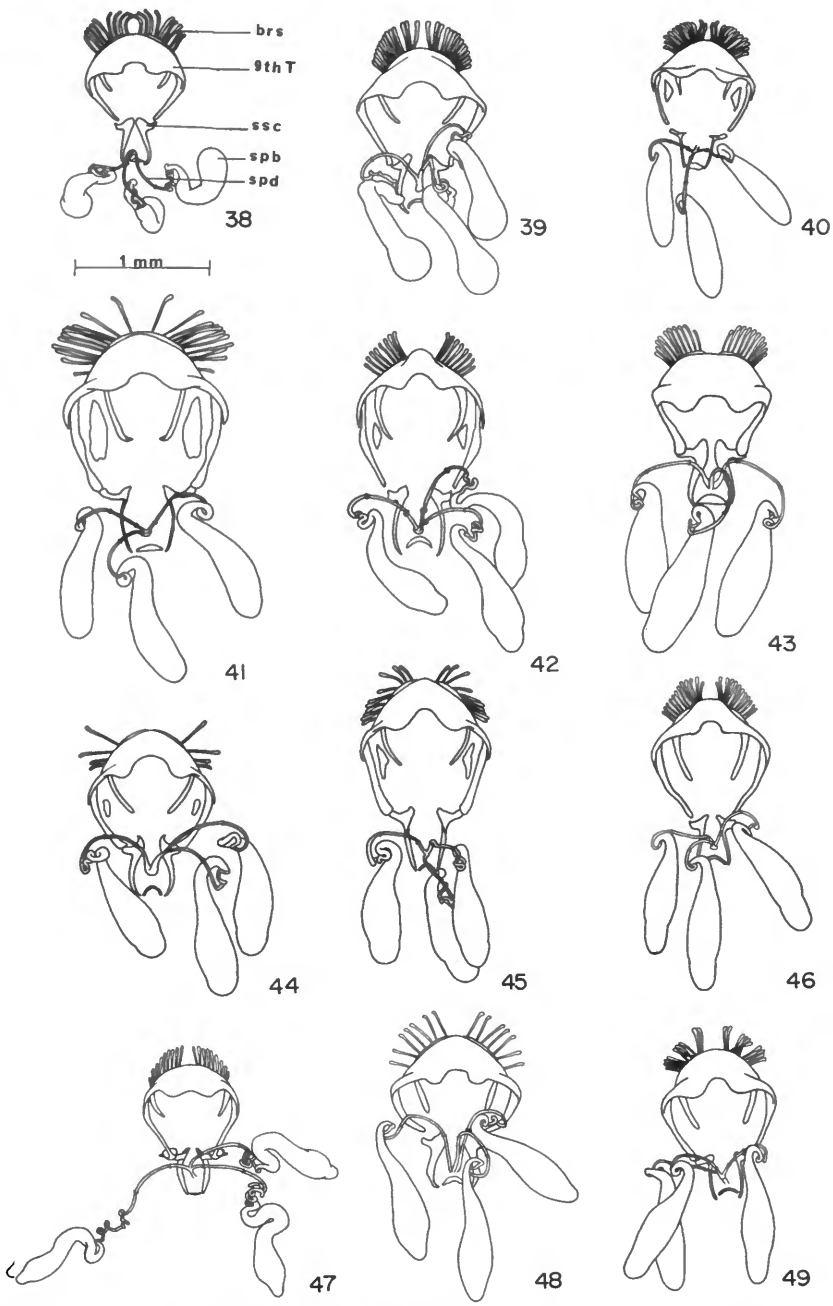
FIGURE 7.—Hypothetical evolutionary scheme for the *tigrinus* group of the genus *Anthrax*, showing postulated point of origin, patterns of dispersal, and locations of isolating barriers.



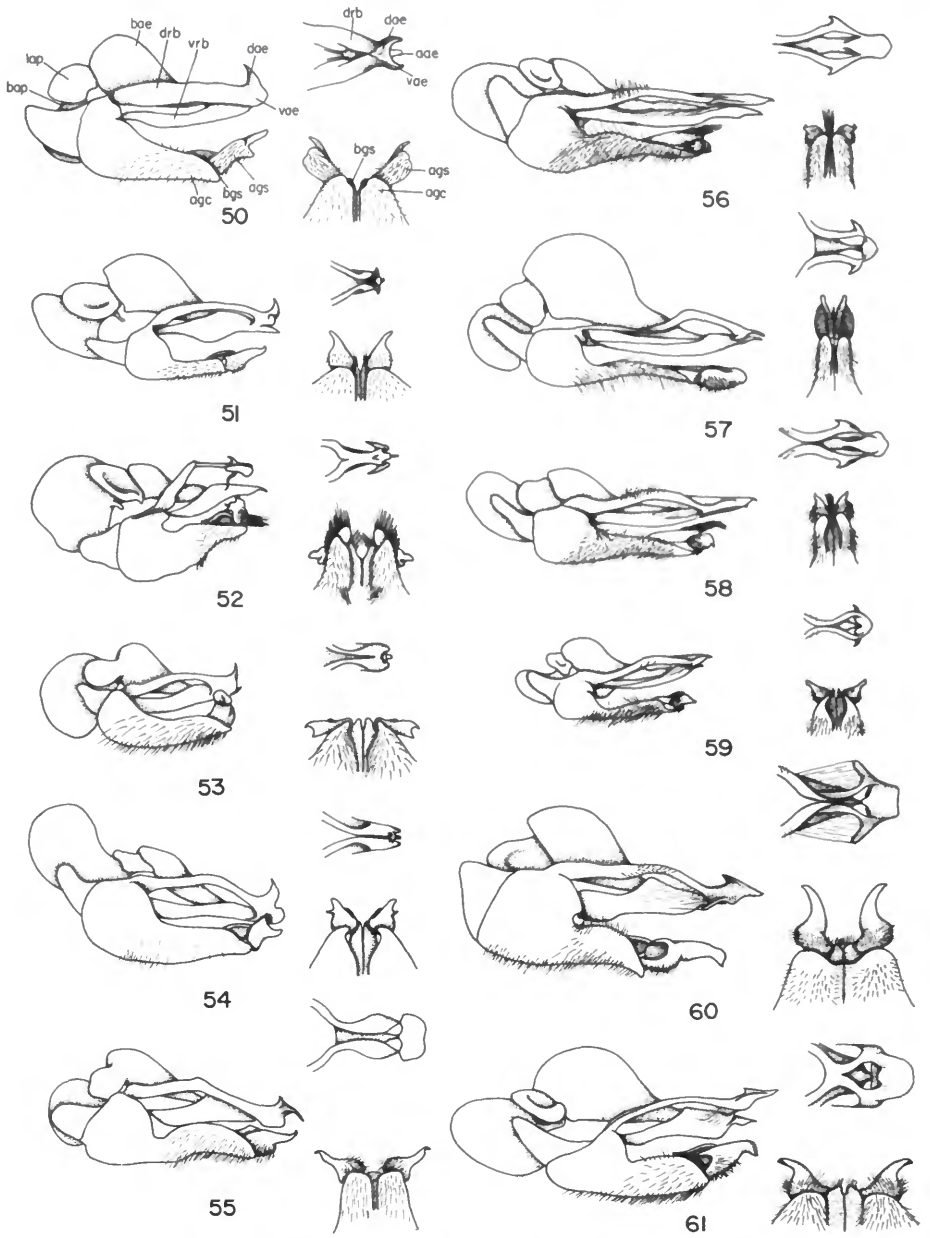
FIGURES 8–27.—Lateral view of male genitalia of *Anthrax* (inset shows distal segment of gonostylus in ventromedial view): 8, *cintalpa;* 9, *irroratus irroratus* (9*a*, anteroventral view of epiphallus); 10, *peruvianus;* 11, *inordinatus;* 12, *cordillerensis;* 13, *oedipus oedipus.* Dorsal view of right antenna of *Anthrax:* 14, *cintalpa;* 15, *irroratus irroratus;* 16, *oedipus oedipus.* Representative scales found in *Anthrax* (not drawn to scale): 17, ovate; 18, ovate-truncate; 19, obovate-truncate; 20, linear; 21, lanceolate; 22, lanceolate truncate; 23, oblanceolate; 24, oblanceolate truncate; 25–26, curly. 27, Representative hair from a tuft of pile. Abbreviations: *aae,* apex of aedeagus; *agc,* apex of gonocoxite; *ae,* apex of epiphallus; *bae,* bulb of aedeagus; *bap,* basal apodeme of aedeagus; *bgs,* basal segment of gonostylus; *cer,* cercus; *dgs,* distal segment of gonostylus; *drb,* dorsal band; *lap,* lateral apodeme of aedeagus; *epm,* epandrium.



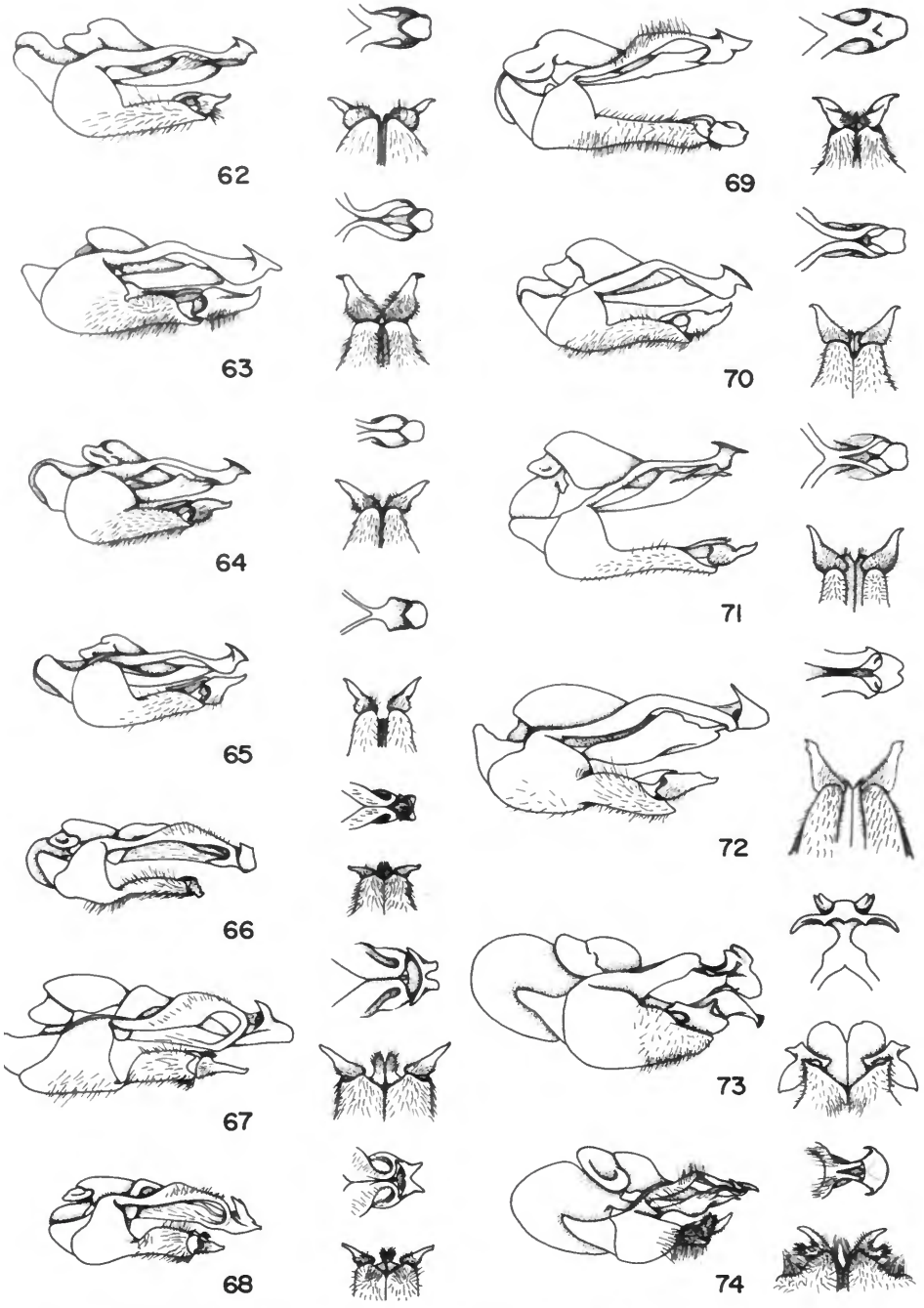
FIGURES 28–37.—Lateral view of male genitalia of *Anthrax:* 28, *seriepunctatus;* 29, *cybele;* 30, *stellans;* 31, *atriplex;* 32, *melanopogon;* 33, *insulanus;* 34, *pluto pluto;* 35, *pluto nigriventris.* Anterior view of middle legs of *Anthrax:* 36, *cintalpa;* 37, *oedipus oedipus.*



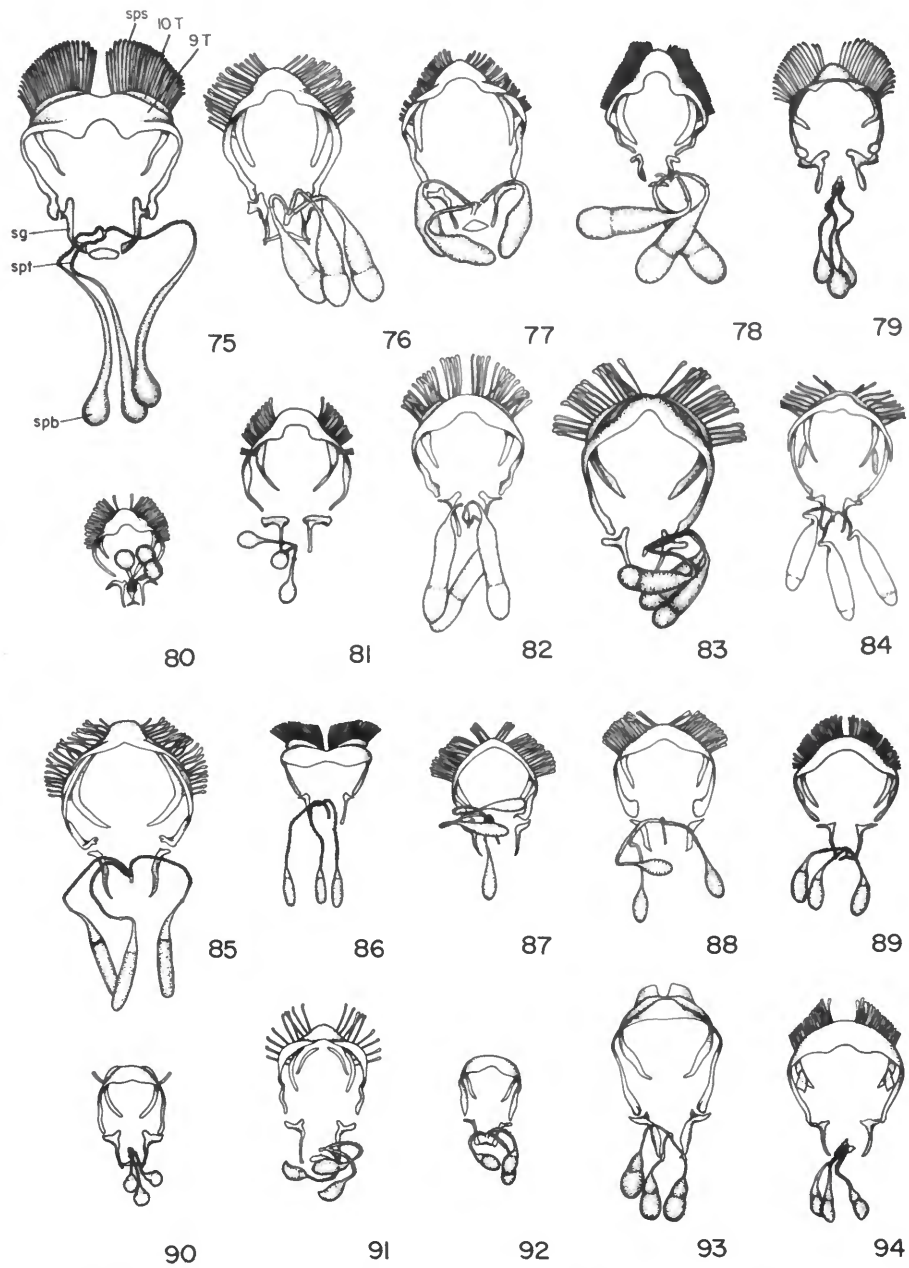
FIGURES 38–49.—Anterodorsal view of female genitalia of *Anthrax:* 38, *irroratus irroratus;* 39, *irroratus striatipennis;* 40, *cybele;* 41, *pluto pluto;* 42, *seriepunctatus;* 43, *cordillerensis;* 44, *insulanus;* 45, *atriplex;* 46, *peruvianus;* 47, *cintalpa;* 48, *inordinatus;* 49, *oedipus oedipus.* Abbreviations: *brs,* bristles; *spb,* bulb of spermatheca; *spd,* duct of spermatheca; *ssc,* sclerite on each side of spermathecal duct; *9th T,* ninth tergum.



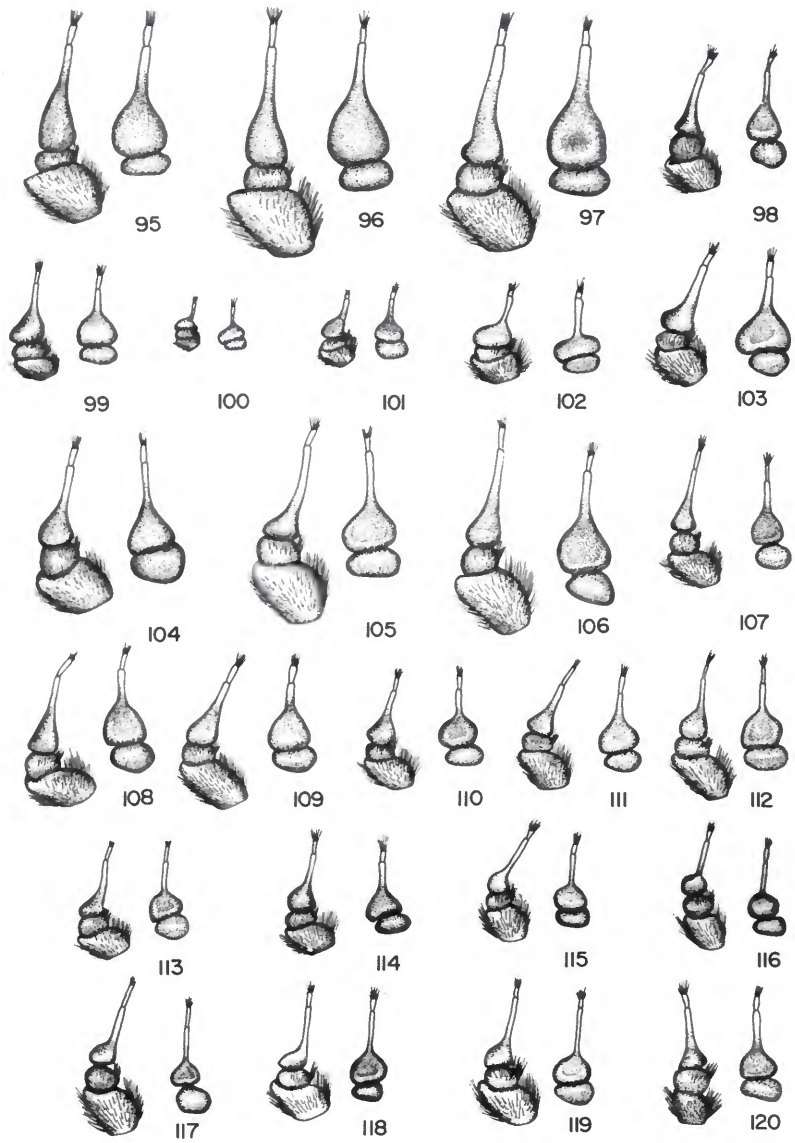
FIGURES 50–61.—Male genitalia of *Anthrax*, lateral view (at right: above, dorsal view of the apex of epiphallus and below, ventral view of apices of the gonocoxites and gonostyli): 50, *argentatus;* 51, *nitidus;* 52, *hylaios;* 53, *cathetodaithmos;* 54, *luctuosus;* 55, *koebelei;* 56, *aterrimus;* 57, *hyalacrus;* 58, *midas;* 59, *cephus;* 60, *pluricellus;* 61, *snowi.* Abbreviations: *aae,* apex of aedeagus; *agc,* apex of gonocoxite; *ags,* apical segment of gonostylus; *bae,* base of aedeagus; *bap,* basal apodeme of aedeagus; *bgs,* basal segment of gonostylus; *dae,* dorsal part of apex of epiphallus; *drb,* dorsal band; *lap,* lateral apodeme of aedeagus; *vae,* ventrolateral part of apex of epiphallus; *vrb,* ventral band.



FIGURES 62–74.—Male genitalia of *Anthrax*. (At right: above, dorsal view of apex of epiphallus and below, ventral view of apices of gonocoxites and gonostyli): 62, *clinopictus;* 63, *gideon;* 64, *analis;* 65, *repertus;* 66, *argyropygus argyropygus;* 67, *argyropygus albosparsus;* 68, *argyropygus painteri;* 69, *angustipennis;* 70, *macquarti;* 71, *austrinus;* 72, *laticellus;* 73, *innubilipennis;* 74, *delicatulus.*



FIGURES 75–94.—*Anthrax*, dorsointerior view of female genitalia: 75, *aterrimus;* 76, *midas;* 77, *cephus;* 78, *hyalacrus;* 79, *hylaios;* 80, *cathetodaithmos;* 81, *luctuosus;* 82, *costaricensis;* 83, *pluricellus;* 84, *argentatus;* 85, *angustipennis;* 86, *argyropygus argyropygus;* 87, *argyropygus albosparsus;* 88, *argyropygus painteri;* 89, *macquarti;* 90, *repertus;* 91, *clinopictus;* 92, *funebris;* 93, *analis;* 94, *gideon*. Abbreviations: *sg*, sclerite on each side of gonopore; *spb*, bulbs of spermathecae; *sps*, spines on tenth tergum; *9T*, ninth tergum; *10T*, tenth tergum.



FIGURES 95–120.—*Anthrax,* dorsal (left) and mesal (right) views of antennae: 95, *midas;* 96, *aterrimus;* 97, *cephus;* 98, *hyalacrus;* 99, *luctuosus;* 100, *inaquosum;* 101, *nitidus;* 102, *argentatus;* 103, *hylaios;* 104, *snowi;* 105, *pluricellus;* 106, *costaricensis;* 107, *angustipennis;* 108, *delicatulus;* 109, *innubilipennis;* 110, *argyropygus argyropygus;* 111, *argyropygus albosparsus;* 112, *argyropygus painteri;* 113, *macquarti;* 114, *austrinus;* 115, *funebris;* 116, *analis;* 117, *gideon;* 118, *clinopictus;* 119, *repertus;* 120, *laticellus.*

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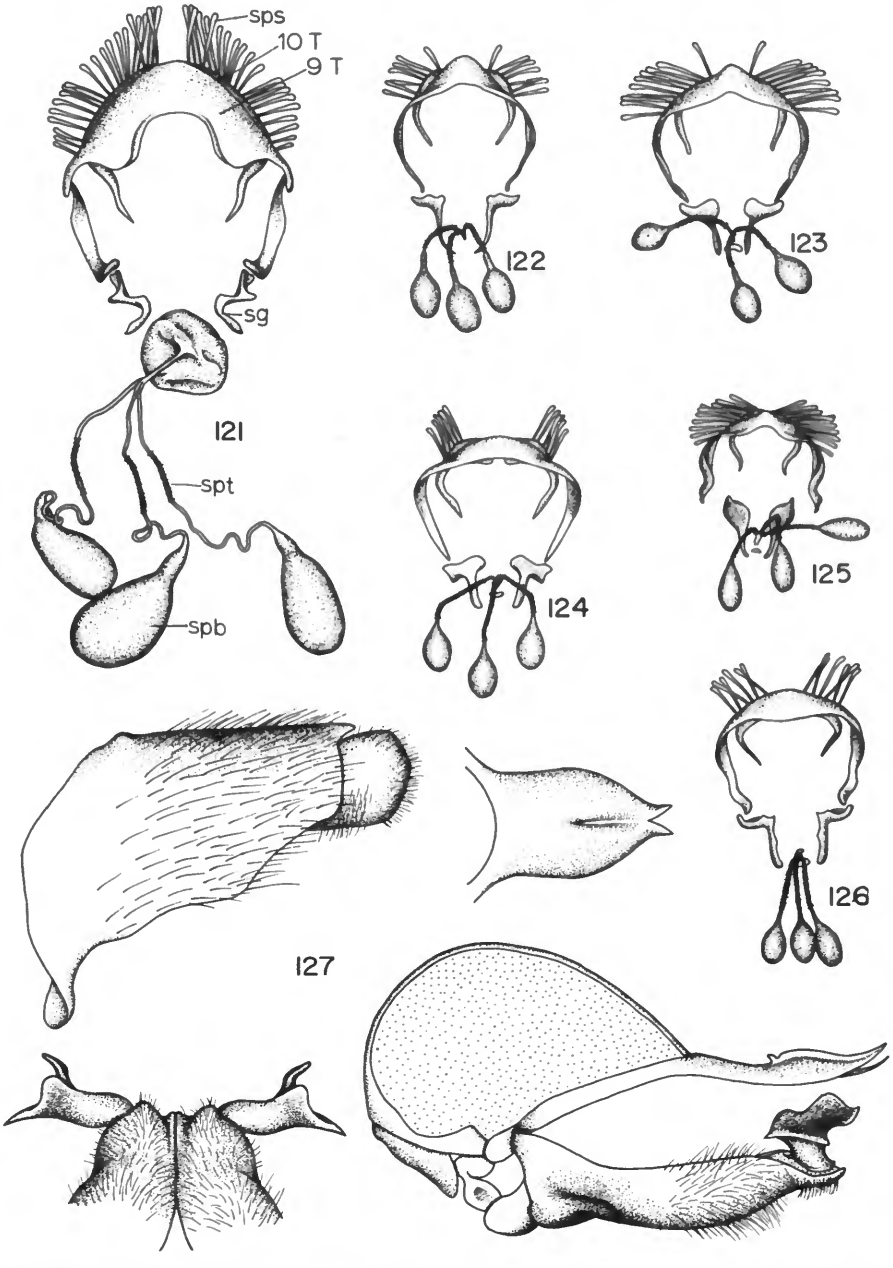
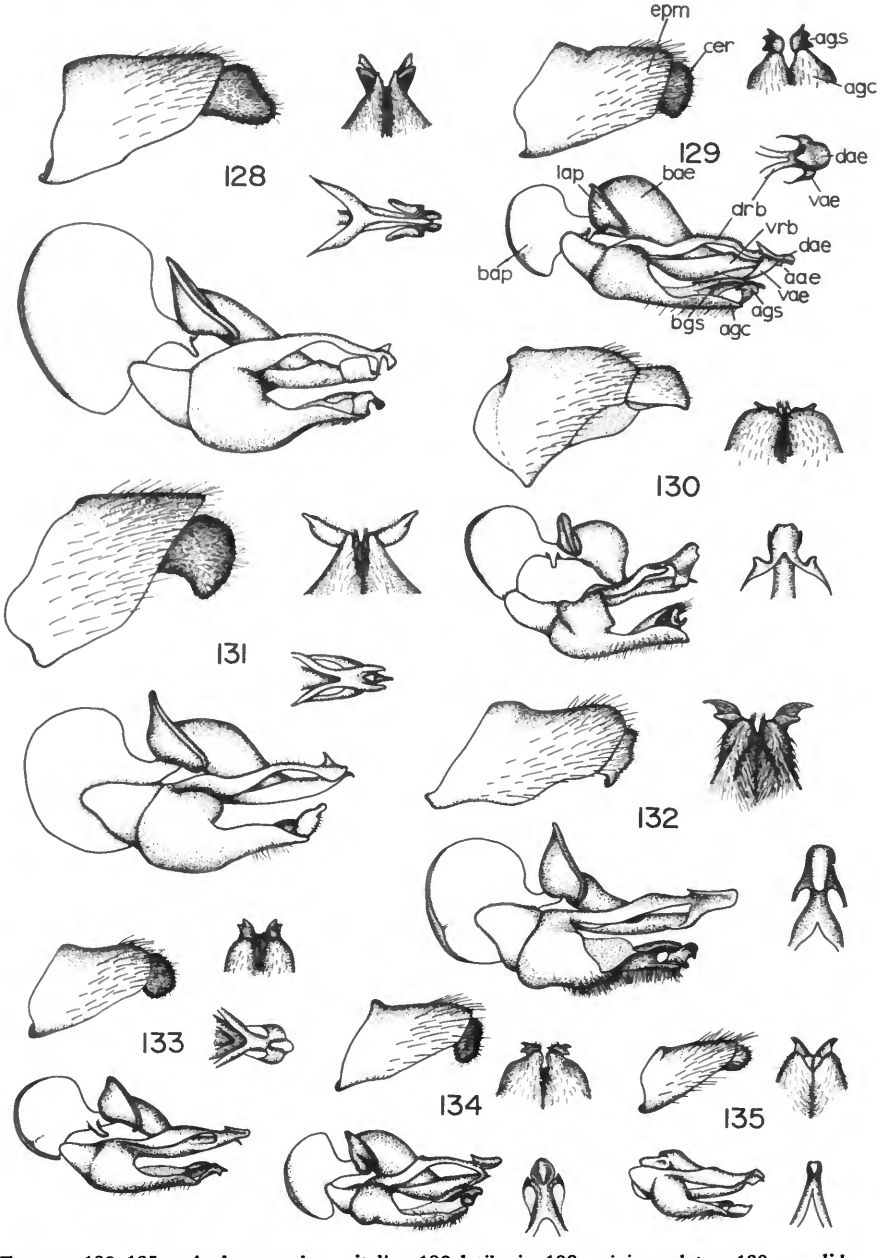


FIGURES 121–127.—*Anthrax*, female genitalia: 121, *simson habrosus;* 122, *caatingensis;* 123, *bellulus;* 124, *latibasis;* 125, *trimaculatus;* 126, *mystaceus. Anthrax simson habrosus;* 127, male genitalia. Abbreviations: *sg*, sclerite on each side on gonopore; *spb*, spermathecal bulb; *sps*, spines on tenth tergum; *spt*, spermathecal tubes; *9T*, ninth tergum; *10T*, tenth tergum.



FIGURES 128–135.—*Anthrax,* male genitalia: 128 *latibasis;* 129, *minimaculatus;* 130, *squalidus;* 131, *baliopteros;* 132, *trimaculatus;* 133, *bellulus;* 134, *mystaceus;* 135, *plurinotus.* Abbreviations: *aae,* apex of aedeagus; *agc,* apex of gonocoxite; *ags,* apex of gonostylus; *bae,* base of aedeagus; *bap,* basal apodeme of aedeagus; *bgs,* basal segment of gonostylus; *cer,* cercus; *dae,* dorsal part of apex of epiphallus; *drb,* dorsal band; *epm,* epandrium; *lap,* lateral apodeme of aedeagus; *vae,* ventrolateral part of apex of epiphallus; *vrb,* ventral band.

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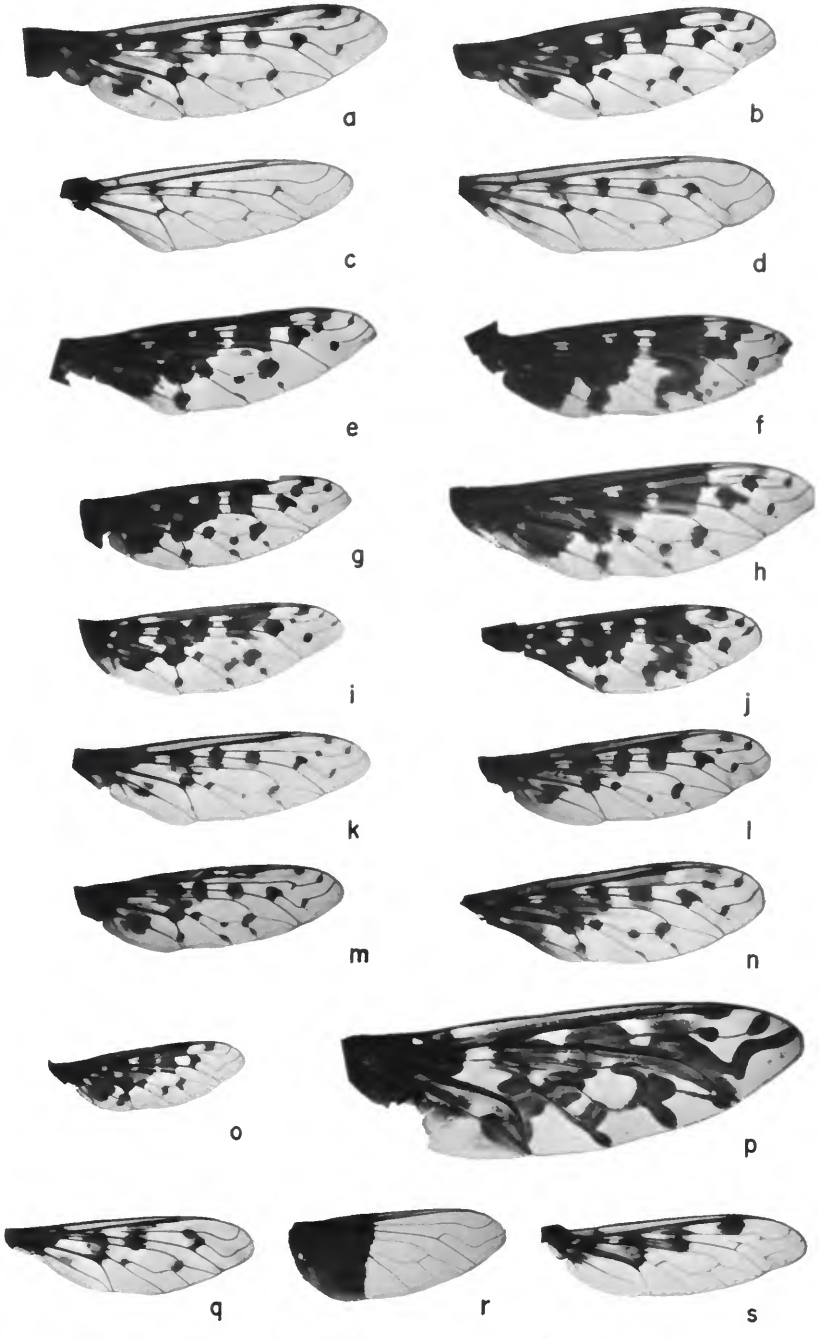

PLATE 2.—Wings of *Anthrax: a, stellans,* ♂ ; *b, stellans,* ♀ ; *c, seriepunctatus,* ♂ ; *d, seriepunctatus,* ♀ ; *e, pluto pluto,* ♂ ; *f, pluto pluto,* ♀ ; *g, pluto nigriventris,* ♂ ; *h, pluto nigriventris,* ♀ ; *i, insulanus,* ♂ ; *j, insulanus,* ♀ ; *k, atriplex,* ♂ ; *l, atriplex,* ♀ ; *m, melanopogon,* ♂ ; *n, melanopogon,* ♀ ; *o, cybele; p, tigrinus; q, varicolor varicolor; r, luctuosus; s, trimaculatus.*

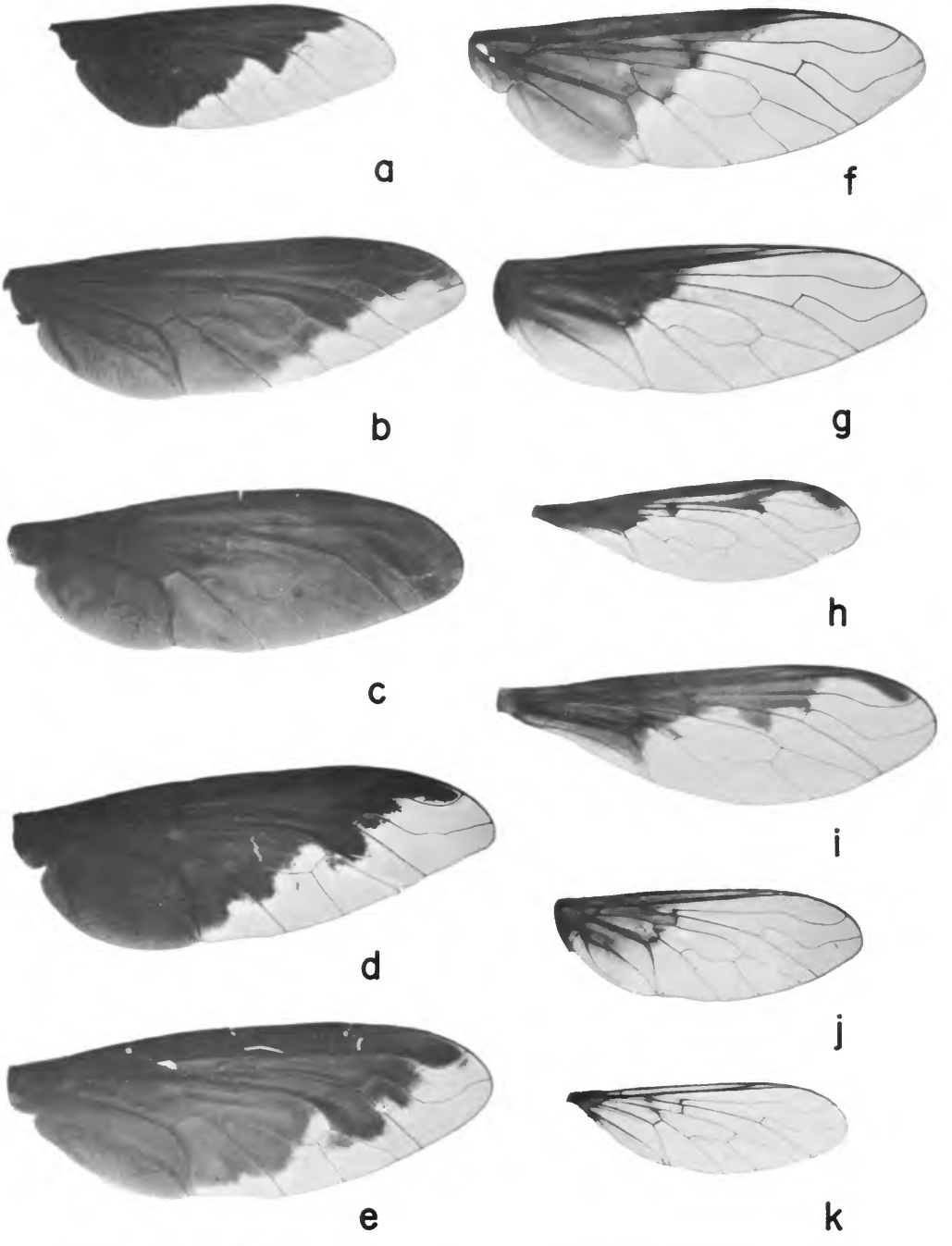

PLATE 3.—Wings of *Anthrax; a, analis,* typical form, ♀ ; *b, analis,* form *grossbecki,* ♂ ; *c, analis,* form *grossbecki,* ♀ ; *d, analis,* form *cedens,* ♂ ; *e, analis,* form *cedens,* ♀ ; *f, argentatus,* ♂ ; *g, xanthomeros,* ♀ ; *h, argyropygus albosparsus,* ♂ ; *i, argyropygus albosparsus,* ♀ ; *j, nitidus,* ♀ ; *k, inaquosum,* ♀.

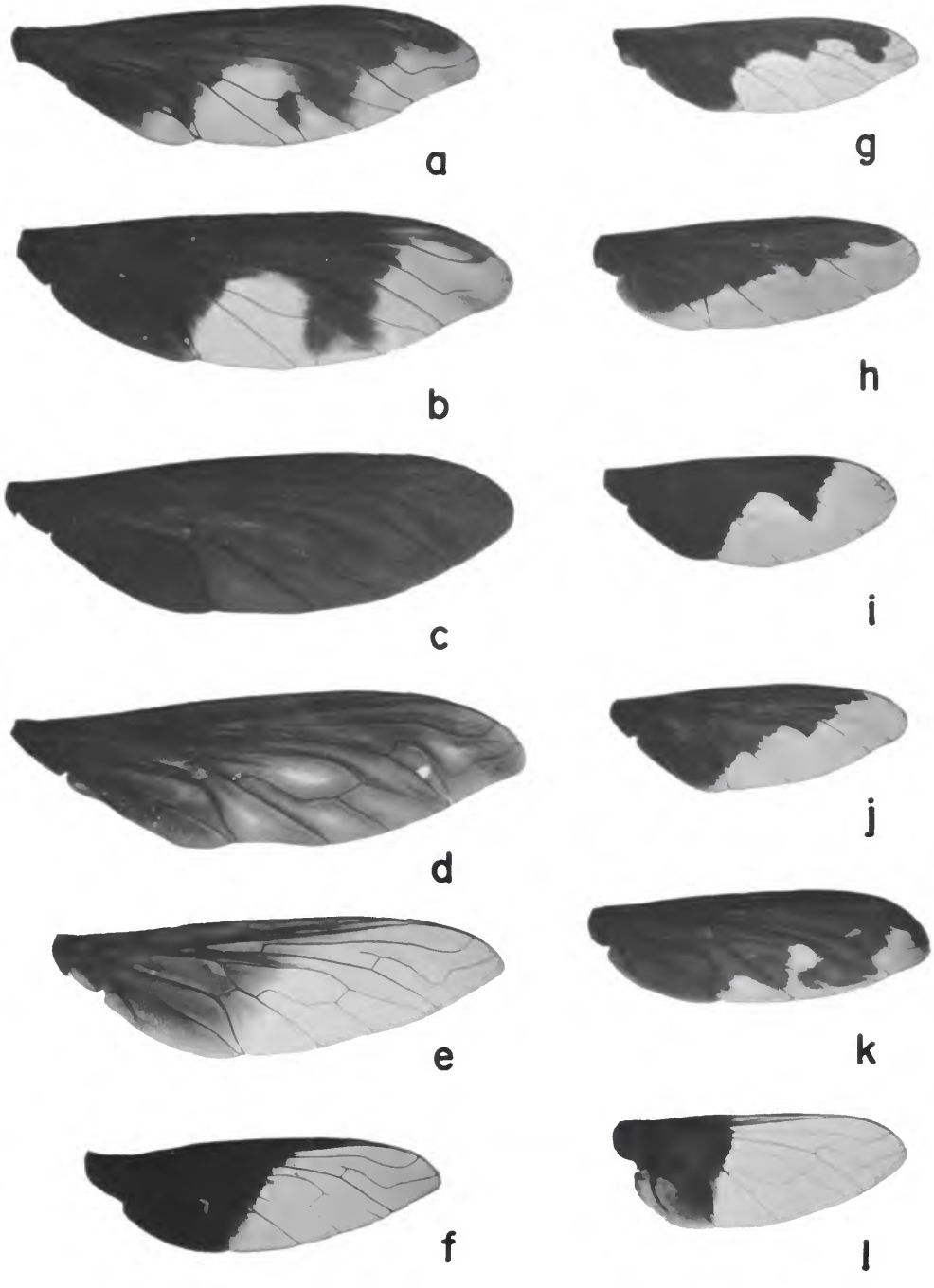

PLATE 4.—Wings of *Anthrax: a, snowi,* ♂ ; *b, costaricensis,* ♀ ; *c, cephus,* ♀ ; *d, aterrimus,* ♀ ; *e, midas,* ♀ ; *f, hyalacrus,* ♂ ; *g, hylaios,* ♀ ; *h, clinopictus,* ♂ ; *i, gideon,* ♀ ; *j, repertus,* ♂ ; *k, funebris,* ♀ ; *l, luctuosus,* ♀ .

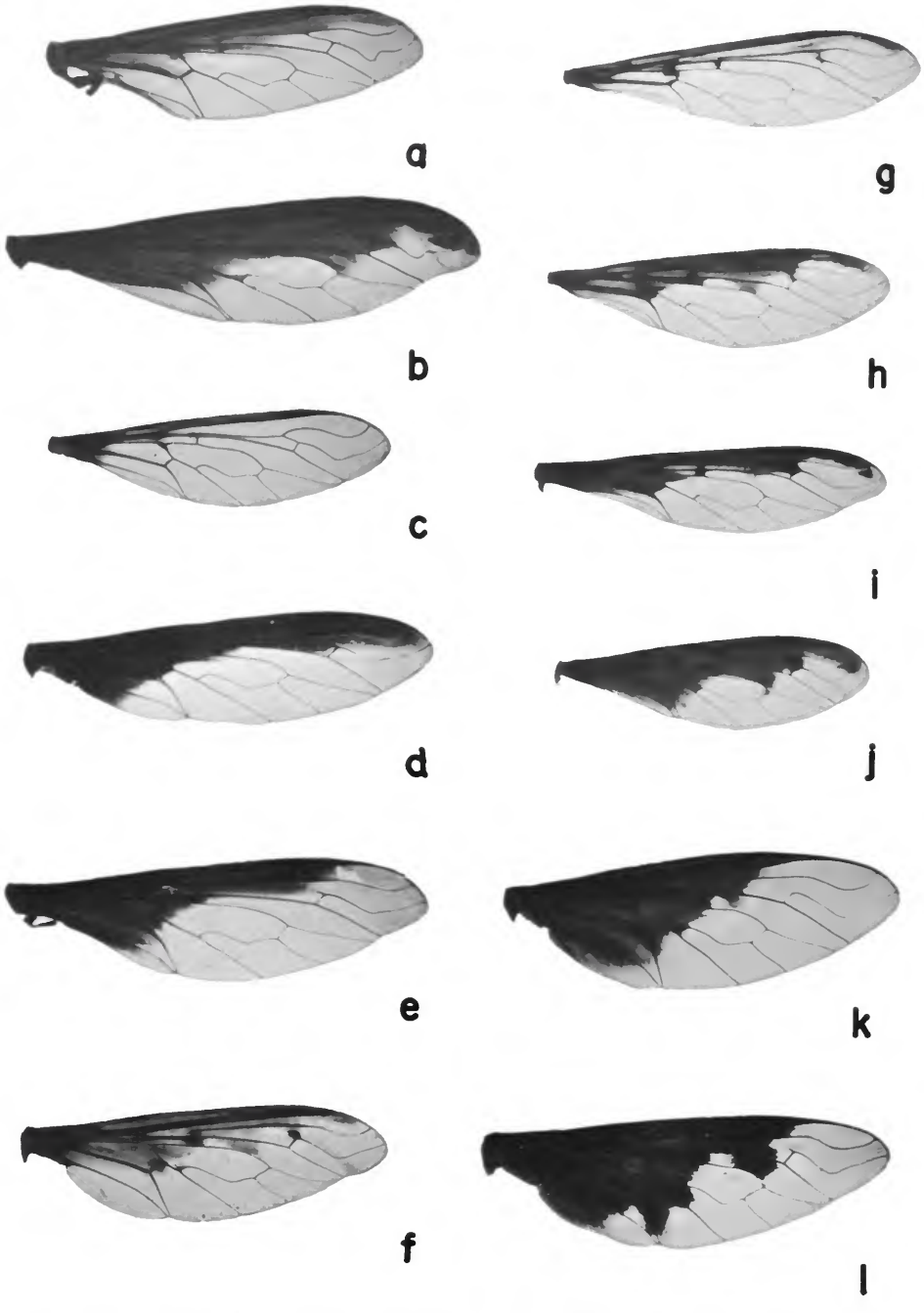

PLATE 5.—Wings of *Anthrax: a, delicatulus,* ♂ ; *b, delicatulus,* ♀ ; *c, innubilipennis,* ♂ ; *d, angustipennis,* ♂ ; *e, angustipennis,* ♀ ; *f, laticellus,* ♂ ; *g, argyropygus painteri,* ♂ ; *h, argyropygus painteri,* ♀ ; *i, argyropygus argyropygus,* ♂ ; *j, argyropygus argyropygus,* ♀ ; *k, macquarti,* ♀ ; *l, austrinus,* ♀ .

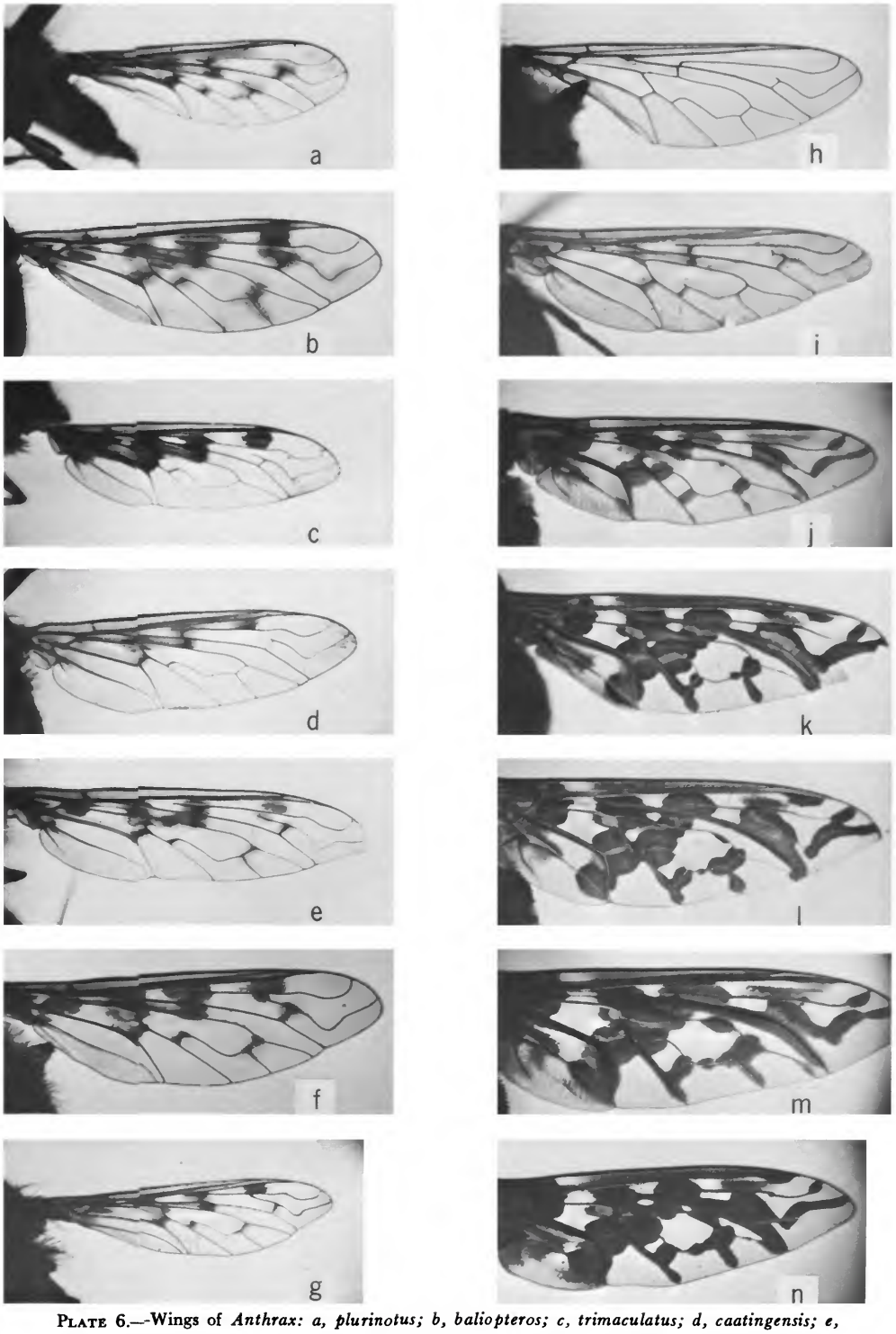

PLATE 6.—Wings of *Anthrax: a, plurinotus; b, baliopteros; c, trimaculatus; d, caatingensis; e, minimaculatus; f, latibasis; g, bellulus; h, squalidus; i, mystaceus; j, delila; k, simson simson; l, simson habrosus; m, xylocopae; n, tigrinus.*

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Anthrax Species

(Synonyms and homonyms are in *italics*, pages with principal accounts are in **boldface**.)

Insect Hosts

U.S. GOVERNMENT PRINTING OFFICE: 1970 O—369-673

Publication in *Smithsonian Contributions to Zoology*

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