A Revision and Cladistic Analysis of the Spider Family Pimoidae (Araneoidea: Araneae)

GUSTAVO HORMIGA
Emphasis upon publication as a means of "diffusing knowledge" was expressed by the first Secretary of the Smithsonian. In his formal plan for the Institution, Joseph Henry outlined a program that included the following statement: "It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge." This theme of basic research has been adhered to through the years by thousands of titles issued in series publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

- *Smithsonian Contributions to Anthropology*
- *Smithsonian Contributions to Astrophysics*
- *Smithsonian Contributions to Botany*
- *Smithsonian Contributions to the Earth Sciences*
- *Smithsonian Contributions to the Marine Sciences*
- *Smithsonian Contributions to Paleobiology*
- *Smithsonian Contributions to Zoology*
- *Smithsonian Folklife Studies*
- *Smithsonian Studies in Air and Space*
- *Smithsonian Studies in History and Technology*

In these series, the Institution publishes small papers and full-scale monographs that report the research and collections of its various museums and bureaux or of professional colleagues in the world of science and scholarship. The publications are distributed by mailing lists to libraries, universities, and similar institutions throughout the world.

Papers or monographs submitted for series publication are received by the Smithsonian Institution Press, subject to its own review for format and style, only through departments of the various Smithsonian museums or bureaux, where the manuscripts are given substantive review. Press requirements for manuscript and art preparation are outlined on the inside back cover.

Robert McC. Adams  
Secretary  
Smithsonian Institution
A Revision and Cladistic Analysis of the Spider Family Pimoidae (Araneoidea: Araneae)

Gustavo Hormiga
ABSTRACT

Hormiga, Gustavo. A Revision and Cladistic Analysis of the Spider Family Pimoidae (Araneoidea: Araneae). *Smithsonian Contributions to Zoology*, 549, 104 pages, 442 figures, 1 table, 1994.—The spider family Pimoidae is revised at the species level. Twenty-one species, including 11 new species, are recognized in the Pimoidae. All species, including those under the junior synonym *Louisfagea* (Fage), are grouped in the genus *Pimoa* Chamberlin and Ivie. Pimoids are distributed in western North America, southern Europe, and Asia. A numerical cladistic analysis of the interrelationships of the Pimoidae was performed, focusing mainly on classical characters (such as genital and somatic morphology) and spinneret spigot morphology. Nine linyphiid species and the genera *Tetragnatha* and *Zygiella* were used as outgroups for assessing character polarities. Cladograms hypothesizing the interrelationships of pimoids and the sample of linyphiid taxa are provided. The monophyly of pimoids is confirmed. The Linyphiidae are hypothesized as the sister group of Pimoidae.
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Acknowledgments</td>
<td>2</td>
</tr>
<tr>
<td>Materials and Methods</td>
<td>2</td>
</tr>
<tr>
<td>List of Abbreviations Used in the Text and Figures</td>
<td>4</td>
</tr>
<tr>
<td>Taxonomic History</td>
<td>4</td>
</tr>
<tr>
<td>Comparative Morphology of the Pimoids and Characters for the Phylogeny of Pimoidae</td>
<td>5</td>
</tr>
<tr>
<td>Male Genitalia</td>
<td>5</td>
</tr>
<tr>
<td>Female Genitalia</td>
<td>8</td>
</tr>
<tr>
<td>Somatic Morphology</td>
<td>9</td>
</tr>
<tr>
<td>Spinneret Spigot Morphology</td>
<td>11</td>
</tr>
<tr>
<td>Behavior</td>
<td>11</td>
</tr>
<tr>
<td>Familial Placement, Cladistic Analysis, and Phylogenetic Relationships of the Pimoids</td>
<td>11</td>
</tr>
<tr>
<td>Taxonomic Considerations</td>
<td>17</td>
</tr>
<tr>
<td>Biogeography</td>
<td>18</td>
</tr>
<tr>
<td>Taxonomic Revision</td>
<td>19</td>
</tr>
<tr>
<td>PIMOIDEA Wunderlich</td>
<td>19</td>
</tr>
<tr>
<td>Pimoa Chamberlin and Ivie</td>
<td>19</td>
</tr>
<tr>
<td>Key to the Species of Pimoa</td>
<td>25</td>
</tr>
<tr>
<td>Males</td>
<td>25</td>
</tr>
<tr>
<td>Females</td>
<td>26</td>
</tr>
<tr>
<td>Pimoa rupicola (Simon)</td>
<td>27</td>
</tr>
<tr>
<td>Pimoa breuili (Fage)</td>
<td>32</td>
</tr>
<tr>
<td>Pimoa cthulhu, new species</td>
<td>39</td>
</tr>
<tr>
<td>Pimoa vera Gertsch</td>
<td>45</td>
</tr>
<tr>
<td>Pimoa hespera (Gertsch and Ivie)</td>
<td>46</td>
</tr>
<tr>
<td>Pimoa mono, new species</td>
<td>50</td>
</tr>
<tr>
<td>Pimoa haden Chamberlin and Ivie</td>
<td>52</td>
</tr>
<tr>
<td>Pimoa jellisoni (Gertsch and Ivie)</td>
<td>57</td>
</tr>
<tr>
<td>Pimoa gandhii, new species</td>
<td>60</td>
</tr>
<tr>
<td>Pimoa crispa (Fage)</td>
<td>63</td>
</tr>
<tr>
<td>Pimoa indiscreta, new species</td>
<td>66</td>
</tr>
<tr>
<td>Pimoa sinuosa, new species</td>
<td>67</td>
</tr>
<tr>
<td>Pimoa nematoide, new species</td>
<td>71</td>
</tr>
<tr>
<td>Pimoa anatolica, new species</td>
<td>73</td>
</tr>
<tr>
<td>Pimoa altioculata (Keyserling)</td>
<td>75</td>
</tr>
<tr>
<td>Pimoa petita, new species</td>
<td>82</td>
</tr>
<tr>
<td>Pimoa breviata Chamberlin and Ivie</td>
<td>83</td>
</tr>
<tr>
<td>Pimoa curtata Chamberlin and Ivie</td>
<td>87</td>
</tr>
<tr>
<td>Pimoa laurae, new species</td>
<td>92</td>
</tr>
<tr>
<td>Pimoa edenticulata, new species</td>
<td>94</td>
</tr>
<tr>
<td>Pimoa mephitis, new species</td>
<td>98</td>
</tr>
<tr>
<td>Literature Cited</td>
<td>103</td>
</tr>
</tbody>
</table>
A Revision and Cladistic Analysis of the Spider Family Pimoidae
(Araneoidea: Araneae)

Gustavo Hormiga

Introduction

The spiders of the family Pimoidae have long been a controversial taxonomic problem, as evidenced by the different familial placements they have had over the years. Pimoids are a relictual group, with a small number of taxa (formerly less than a dozen of species were known) distributed in the west coast of North America, Europe (the Alps and the Apennines, and northern Spain), and the Himalayas.

A mixture of derived and primitive characters made them bounce from one taxon into another, depending on how systematists weighed different characters. Although some of the first described pimoid species were initially considered as linyphiids, they certainly did not perfectly fit into the Linyphiidae family diagnosis. Not until the 1970s was their palpal morphology studied in detail with the intention of establishing homologies across the several possible families where they might have been placed. Thaler (1976) found it impossible to place them in linyphiids because of their palpal anatomy. He considered them, at least provisionally, tetragnathids. Wunderlich (1986) reexamined the problem and concluded that they were in fact the most basal group within the linyphiids.

Understanding pimoids is crucial for the study of the linyphiid phylogeny. Resolving the phylogenetic position of linyphiids within the Araneoidea will be critical for the understanding of the evolution and relationships of the major groups within this large and diverse superfamily.

The corroborations of the sister group relationship of pimoids and linyphiids proposed by Wunderlich is the first necessary step in the study of linyphiid higher level systematics. Because the most commonly used method for assessing character polarities is outgroup comparison, we need a hypothesis of the cladistic relationships of the pimoids to study the interrelationships of linyphiids. In this paper I have revised the pimoids, redescribed the known species, and described ten new species from North America and Asia. I have assembled a dataset based on comparative morphology to study pimoid phylogenetic relationships using numerical cladistic methods.

One of the methodological problems one first encounters is the “design” of the dataset. Of course one tries to maximize the number of characters in order to increase the support of the phylogeny, however a different approach has to be taken when selecting the taxa. To study the pimoid relationships I included all the species I was able to gather. But how does one select a “representative” sample of linyphiids, the second largest spider family in terms of described generic diversity? The goal of this study is not to present a detailed phylogenetic hypothesis of linyphiid interrelationships, but to understand the cladistic structure of pimoids and how it might affect the phylogeny of linyphiids. Linyphiid diversity has motivated taxonomists for decades, and many new species and genera are still being documented. Unfortunately this enthusiasm is not evident at the suprageneric level. The higher level systematics of linyphiids are very poorly understood. Adequate systematic studies exploring the phylogenetic structure of the family and their relationships to other araneoids are lacking, although a few monophyletic groups can be characterized from the published work of some arachnologists. This is probably due, at least in part, to the fact that linyphiids are a taxonomically “difficult” group for several reasons. First, linyphiids (especially erigonines) are small in size, and therefore it can be cumbersome to work with them. Second, the characters used for their classification are mainly genitalic, and difficult to study accurately. Also, their small size seems to invite superficial description of their genitalic morphology. Third, homoplasies seem to be rampant, different characters systems are incongruent and seem to suggest different hypotheses of relationship.
I have followed Wunderlich's (1986) scheme for the subfamily structure of linyphiids to select the sample of linyphid taxa for the dataset. Two genera have been chosen for each subfamily, except for the monogeneric Stemonyphantinae. Thus, in addition to the pimoids the dataset contains the following outgroups: nine linyphiids (Linyphia triangularis (Clerck) and Microlynphia dana (Chamberlin and Ivie) (Linyphiinae, Linyphiini); Bolymphantes luteolus (Blackwall) and Leptophantes tenus (Blackwall) (Linyphiinae, Micronetini); Erigone psychrophiia Thorell and Walckenaeria directa (O. P.-Cambridge) (Erigoninae); Haplinis diloris (Urquhart) and Novafoneta vulgaris Bles (Mynogleninae); and Stemonyphantes hlauveltae Gertsch (Stemonyphantinae)) plus two genera outside the pimoid-linyphiid assemblage that represent the families that have been hypothesized as sister to linyphiids: Zygiaella x-notata (Clerck) (Aranidae) and Tetragnatha versicolor (Blackwall) (Tetragnathidae). With this dataset I also intend to test Wunderlich's hypothesis of subfamilial relationships. In the present paper I present and discuss the revision and cladistic structure of pimoids. The problems of its implications for the phylogeny of linyphiids are discussed in detail elsewhere (Hormiga, 1993).

ACKNOWLEDGMENTS

Specimens for study were kindly made available by the following institutions and individuals:

AMNH American Museum of Natural History, New York, Dr. N. I. Platnick
CAS California Academy of Sciences, San Francisco, Drs. C. Griswold, W. Pulawski and N. Penny, and Mr. D. Ubick
BMNH The Natural History Museum, London, Mr. P.D. Hillyard
CNC Canadian National Collection, Ottawa, Dr. C. Dondale and Mr. J. Redner
DU Mr. D. Ubick, private collection, San Francisco
IZU Institut fur Zoologie der Universitat, Innsbruck, Austria, Dr. K. Thaler
JW Dr. J. Wunderlich, private collection, Straubenthal, Germany
MCZ Museum of Comparative Zoology, Harvard University, Cambridge, Dr. H.W. Levi
MNHN Musee National d'Histoire Naturelle, Paris, France, Dr. C. Rolland
SM Senckenberg Museum, Frankfurt, Germany, Dr. M. Grasshoff
UB Universitat de Barcelona, Departament de Biologia Animal, Barcelona, Spain, Dr. C. Ribera
USNM former United States National Museum, collections in National Museum of Natural History, Smithsonian Institution, Washington, D.C. Dr. J.A. Coddington and Mr. S. Larcher
UW Burke Memorial Washington State Museum, Seattle, Dr. R. Crawford

Jonathan Coddington and Charles Mitter have guided me through all the phases of this study; I am deeply indebted to them for their intellectual stimulation and their continuous support and guidance. I would especially like to thank Jonathan Coddington for his generous (and patient) sharing of ideas and knowledge, from field photography to the intricacies of cladistic analysis. Charles Griswold has been extremely helpful throughout the development of this study; his comments and insights on spider systematics were highly appreciated. Susann Braden and Walter Brown of the NMNH Electron Microscope Facility helped with SEM work. Special thanks to Dr. Rodney Crawford for collecting and mailing me live specimens of Pimoa alticola and for his comments on pimoid habitats; also to Carles Ribera for providing unpublished distribution records from northern Spain. I am indebted to Mr. Vincent Roth for the gift of pimoid specimens from India and for his comments on pimoid habitats. Wayne Maddison and Leticia Avilés must be thanked for their hospitality during my visit to California and their help during our collecting trip to Lake Tahoe. Mr. Darrell Ubick was extremely helpful, providing distribution information on Californian pimoids and collecting some of the undescribed species. I also would like to thank Vic Krantz and the staff of the Smithsonian Institution Photographic Services for their excellent darkroom work, Elaine Hodges and Molly Ryan for their helpful advice for labeling the plates of this work, and George Venable for printing out the computer graphics. Finally, I must thank Laura Garcia de Mendoza for her help throughout the course of this study. Without her moral support and assistance this work might well have never been possible.

This study has been supported by a Graduate Assistantship from the Department of Entomology at the University of Maryland and a Curatorial Fellowship from the Smithsonian Institution. Both institutions provided many of the resources and laboratory facilities that made this study possible. Field work in the Pacific Northwest was financed by grants from the American Museum of Natural History (Theodore Roosevelt Memorial Fund), the California Academy of Sciences (Exline-Frizzell Fund), and the Sigma Xi Society for Scientific Research (Grants-in-Aid).

I would like to thank Jonathan Coddington, Charles Mitter, Robert Denno, and Douglass Miller (University of Maryland), and Charles Dondale (Biosystematics Research Centre, Ottawa), Charles Griswold (California Academy of Sciences, San Francisco), Peter van Helsing (Rijksmuseum van Natuurlijke Historie, Leiden), Konrad Thaler (Institut für Zoologie der Universität, Innsbruck), and Jörg Wunderlich (Straubenthal) for their comments on an earlier version of this manuscript.

Materials and Methods

Specimens were examined and illustrated using a Wild M-5 stereoscopic microscope, with a Wild 1.25 × camera lucida. Further details were studied using a Leitz Ortholux II compound microscope and an Olympus BH-2 compound microscope, and illustrated using an Olympus 1.25 × drawing tube. SEM services were provided by the Cambridge Stere-
All measurements are in millimeters. Somatic morphology measurements were taken using a grid reticle in the dissecting microscope. Eye diameter and interocular distances are taken from the span of the lens. When the lens outline was not circular the diameter was measured at the widest point. The cephalothorax length and height were measured in lateral view and its width was taken at the widest point. Similarly, the length and height of the abdomen was measured in lateral view, and the width as the widest point as seen from a dorsal view. The measurements of the abdomen are only approximations, because the abdomen size changes more easily in preserved specimens than other more sclerotized parts do (e.g., the chelicerae). The total length was measured in lateral view and is also an approximation, because it involves the size of the abdomen and its relative position. Furthermore, it is often the case that we do not know the actual resting position of the abdomen (i.e., more or less vertical or horizontal in reference with the cephalothorax) in the living animal. Leg articles lengths were measured in lateral view without detaching the legs from the animal and positioning the article being measured perpendicularly. The only way to obtain accurate and consistent measurements of leg article lengths is to excise every leg and mount it on a slide. I did not follow such method because it involves the partial destruction of specimens (many species were represented by one or a few specimens) and is very time consuming. For this reason my measurements of leg segments are also approximations. The position of the metatarsal trichobothrium is expressed as in Millidge (1980:105). Female genitalia were excised using microscissors or sharpened needles. With fine needles most of the tissue was cleaned away and the genitalia were then placed in household bleach (suggested by C. Griswold, although I did not need to use a prior trypsin digestion) and watched under the dissecting microscope until most of the non-chitinous tissues were dissolved (usually one to three minutes or less). The specimen was then transferred to distilled water and then to 70% ethanol for examination under the dissecting microscope. For examination with the compound microscope the specimen was transferred to an 85% solution of lactic acid and temporarily mounted as described in Coddington (1983).

Male palps from preserved specimens were expanded by placing them in a concentrated (around 35%) KOH solution for about five minutes, transferring them to distilled water several times and then returning them to alcohol when expansion was obtained. The left palp was illustrated; if otherwise, this is stated. Male palps examined with the SEM were first excised and transferred to a vial with 70% ethanol and then cleaned ultrasonically for one to three minutes. The specimen was then transferred to absolute ethanol and left overnight. After critical point drying, the specimens were glued to rounded rivets using an acetone solution of polyvinyl resin and then coated for examination at the SEM.

For the dissections of tracheal system the specimens were transferred from alcohol into distilled water, where the dorsum of the abdomen (above the pedicel and the spinnerets) was excised with microscissors. Overall the method I followed has been modified from Ray Forster (pers. comm.); but see also Levi (1967), Blest (1976), and Millidge (1984) for methods of study of the tracheal system. First the abdomen was separated from the cephalothorax. For small specimens a small window was cut in the cuticle of the dorsal part of the abdomen. The specimen was then transferred to an excavated slide containing a solution of potassium hydroxide (around 35%), which was placed on a hot plate (up to 230°C-280°C) for several minutes, until most of the soft parts were dissolved. Afterwards the specimen was transferred again into distilled water and the dorsum of the abdomen was excised. The remaining soft tissues were cleaned away with a fine needle under the dissecting microscope. The specimen was then stained in an aqueous solution of chlorazol black (2–3 minutes) and transferred into distilled water where the excess of colorant was washed away. The specimen was then mounted on a slide with a drop of 85% solution of lactic acid, positioned with the help of needles under a dissecting microscope and covered with a cover slip. These preparations were examined with an Olympus BH-2 compound microscope and illustrated using an Olympus 1.25x drawing tube.

Spinneret spigot morphology was examined for every known species of Pimoidae in which females were available. Methods of study and homology assessments follow those of Coddington (1989). When material was available the specimens were examined with the SEM and photographed, otherwise they were examined using a Leitz Ortholux II compound microscope with epi-illumination at 110x.

Autopsy in pimoids was studied using live specimens and museum material. However, for the linyphiids and the outgroups I relied on the museum material determinations and on data from the literature. In live material I grasped one or more legs at the tarsus end with forceps and pulled until the leg broke. Frequently the spider pulled the grasped leg until it broke and ran away afterwards. The museum specimens frequently have broken legs; in most of the cases the legs of linyinfiids and pimoids were broken at the patella-tibia junction. It is not uncommon to find adult specimens in the collections that lost part of one or more legs before being collected, as can be inferred from the “healed” dark tegument that covers the distal end of the segment. In such cases the fracture point is almost invariably at the patella-tibia junction in the pimoids and the linyphiids. But even if the preserved specimen has no broken legs one can detect the predetermined fracture point by gently pulling with a forceps from the distal end of the leg, as suggested by Roth and Roth (1984).

The numerical cladistic analysis was accomplished using the microcomputer package for phylogenetic analysis, Hennig86 version 1.5 (Farris, 1988). See the cladistic analysis section for details of the analysis.
LIST OF ABBREVIATIONS USED IN THE TEXT AND FIGURES

A    alveolus                      AC    aciniform gland spigot(s)
AG   aggregate gland spigot(s)    ALS   anterior lateral spinneret
BH   basal haematodocha          C     conductor
CD   copulatory duct             CDP  cymbial denticulate process
CL   column (stalk)              CO    copulatory opening
CY   cylindrical gland spigot(s) DP    dorsal plate of the epigynum
E    embolus                     ED    ejaculatory duct
EF    epigynal fold              EP    epigynal plug
F    fundus                      FD    fertilization duct
FL    flagelliform gland spigot(s)
m    membrane (or membranous)    MA    median apophysis
MAP   major ampullate gland spigot(s) mAP   minor ampullate gland spigot(s)
pt    prolateral trichobothria (palpal tibia) P    paracymbium
PCS   pimoid cymbial sclerite    Pe    petiole
PEP   pimoid embolic-tergular process
PI    piriform gland spigot(s)   PLS   posterior lateral spinneret
PMS   posterior median spinneret rt    retrolateral trichobothria (palpal tibia)
S    spermatheca                 ST    subtegulum
T    tegulum                     TS    tegular suture
VP    ventral plate of the epigynum

Taxonomic History

The first known pimoid was Labulla rupicola, described by Simon in 1884, from southern Europe. Keyserling described in 1886 the first North American species of Pimoa (altioculata) and also placed it within the linyphiid genus Labulla Simon. In 1931, Fage described the genus Metella breuili from females and juveniles collected in several caves in northern Spain. Fage placed the new genus Metella within the Tetragnathidae (Aranioidae: Tetragnathinae sensu Simon, 1894, 1929). He noted the somatic similarity between that new species and Meta menardi and M. bourneti (Tetragnathidae: Metinae), although several characters clearly separated it from Meta: the eyeplexus height, the extremely long setae covering all the leg articles but the tarsi, and the complexity of the epigynum, which, according to Fage, is similar to that of the North African species of Parameta Simon (Tetragnathidae). Fage was aware of the importance of the study of the palpal characters of the male (unknown at that time) to determine its taxonomic position.

The male of M. breuili was also described and illustrated by Fage (1935). He noticed (page 00) the close relationship between M. breuili and Labulla rupicola, and regarded them as members of the same genus, based mainly on male palpal characters: "La resemblance chez ces deux espèces d'un organe aussi complexe fixe d'une manière certaine leurs affinités." However, Fage also noted differences from the other species of Labulla (viz., Labulla thoracica Wider and L. flahaulti Simon). For that reason he considered it justified to maintain provisionally the genus Metella as a subgenus of Labulla, including in it breuili and rupicola, until these and other poorly delimited genera were revisited. In 1943 Chamberlin and Ivie erected the genus Pimoa to include four pimoid North American species that previously had been placed within Labulla, plus three newly discovered North American species. The diagnosis of the genus (Chamberlin and Ivie, 1943:9) was based mainly on the somatic morphology, although they incorrectly described the chelicerae as lacking any stridulatory striae, a character that has special phylogenetic significance. The only mention of the copulatory organs refers to the paracymbium as fused to the cymbium. Metella crispa, from India, was also described by Fage (1946), who placed it in the vicinity of M. breuili and M. rupicola, resurrecting Metella as a genus of its own, separated from Labulla. He also redefined the genus Metella based mainly on the morphology of the copulatory organs and the characteristic leg hairiness, and stated that the North American species Pimoa altioculata (Keys.), and probably P. hespera (Gertsch and Ivie) and P. jelliisoni (Gertsch and Ivie), also belonged to Metella. In 1951 Gertsch added another new species, making a total of eight North American species.

Roewer (1942:920) maintained the name Metella in his catalog, perhaps because he thought that in the future it would be considered a subgenus of Labulla. Bonnet (1957:2820) noted that the name Metella was preoccupied, aside from being at that time a synonym of Labulla. Bonnet's catalog covered only the literature through 1939 and it was not until 1946 that Fage justified the maintenance of Metella as a separate genus from Labulla).

Brignoli created in 1971 the replacement name Louisfagea for the species under the genus Metella. He also reviewed the possible relationships of this genus, but without providing any new information on the problem. Brignoli (1975:13) did not find a close affinity between Pimoa and Louisfagea, although he recognized that they were somewhat related. Thaler (1976) studied the palpal morphology and the affinities of Louisfagea rupicola. He concluded that the genus should be placed, at least provisionally, within Tetragnathidae and that its placement in Linyphiidae was not possible. Thaler also corroborated the close relationship between Louisfagea and Pimoa, based on palpal homologies, and pointed out the "striking similarity" of Louisfagea's palp to that of Cyatholipus (Cyatholipidae).

Wunderlich (1979) synonymized Louisfagea and Pimoa under the fossil genus Acrometa Petrunkevitch and erected the
monotypic tribe Acrometini. Such synonymy was not accepted by Brignoli (1979:36), who based his criticism mainly in the palpal differences between *Pimoa* and *Louisfagea*, and *Acrometa*, and in their geographic distribution (see discussion under “Taxonomic Considerations”).

In 1986 Wunderlich erected the linyphiid subfamily Pimoinae to include the genera *Louisfagea* and *Pimoa*, and proposed a cladogram for the tribes and subfamilies of Linyphiidae. In his cladogram (p. 106) the Pimoinae stands as the sister group of the rest of the Linyphiidae, but the synapomorphies supporting the groupings of his hypothesis are not explicitly stated, and at least some of them are non-synapomorphic diagnostic features.

Crawford (1988:23) realized the difficulties in having *Pimoa* and *Louisfagea* within Metinae (a tetragnathid subfamily), as well as in any other known family, and concluded that “further study of this group should prove illuminating to phylogenetic studies, and it is probable that separate family status will prove justified.” Millidge (in litt.) completely rejects the placement of *Pimoa* in Linyphiidae, and maybe even in Araneoidea! He thinks that it may require a new family. More recently, Hormiga (1993) synonymized *Louisfagea* with *Pimoa* and raised pimoids to family rank.

### Comparative Morphology of the Pimoids and Characters for the Phylogeny of Pimoidae

The following description describes the main features of pimoid morphology and how they are allocated into the characters and character states used in the cladistic analysis. The explicit character and character state definitions are also given. Because there is a subset of linyphiid taxa in the data set, there are characters that are relevant only for the linyphiid phylogeny. The linyphiid characters are included in the dataset to resolve the linyphiid topology, because the character state optimizations at the outgroup node are needed to determine character polarities by outgroup comparison. These linyphiid characters and phylogeny are discussed elsewhere (Hormiga, 1993).

When necessary for clarity, an exemplar taxon exhibiting the character state being described is given in parentheses, and if possible reference to an illustration is made. The “exemplar character state” is meant to be taken as a reference for future homology assessments, analogous to type species for allocating specimens to a given taxon.

### Male Genitalia

The male palp morphology provides the largest suite of characters for the study of pimoid relationships (37 out of a total of 62 characters). Although male genitalia are commonly used in spider phylogenetic systematics, it can be extremely difficult to establish homologies of the palpal sclerites across a wide range of taxa (for a recent detailed and illuminating discussion on the subject see Coddington, 1990a). Albeit many pimoids had been initially described as linyphiids, their palpal morphology had not been studied in detail. When the palp was first studied and the homologies of its sclerites evaluated (Thaler, 1976; Wunderlich, 1979) a linyphiid placement of pimoids seemed impossible, at least on the basis of palpal morphology. Given the evidence of the linyphiid-pimoid sister relationship provided by non-genitalic characters (stridulatory organ, patellar autospy, spinneret spigot sister relationship provided by non-genitalic characters (stridulatory organ, patellar autospy, spinneret spigot morphology, sheet-web) some of the homologies of the palp sclerites have to be reinterpreted.

**Character 1:** Morphology of the cymbium. 0: without dorsoectal denticulate process; 1: with a dorsoectal cymbial denticulate process (CDP; *breuili*, Figure 44); 2: with a dorsoectal process without denticles (*edenticulata*, Figure 410).

**Character 2:** Denticles of cymbial denticulate process. 0: numerous (more than 20; *rupicola*, Figure 16); 1: fewer (less than 20; *breviata*, Figure 365).

**Character 3:** Apex of dorsoectal denticulate process. 0: not pointed, normal sclerotization; 1: with the distal end pointed and heavily sclerotized (*laurae*, Figure 391).

The presence of a dorsoectal denticulate process on the cymbium (character 1) is a synapomorphy of pimoids, and one of their most conspicuous diagnostic characters. The presence of a second process of this type is autapomorphic for *breuili* (Figure 44). The shape and relative position of this process (characters 2 and 3) vary across taxa, as well as the number and arrangement of denticles or cusuples. The denticles are secondarily absent in *edenticulata* (Figures 410, 426). A relatively large process with numerous denticles (e.g., in *rupicola*, Figures 15–17) seems to be the plesiomorphic state because it is present in the two most basal taxa (this character reverses in *crispa*). The reduction of the size of the process and the number of denticles appears to be a later development (e.g., in *hespera*, Figure 128). A modification of the distal end of the cymbial process (pointed and heavily sclerotized, character 3; Figure 391) provides a synapomorphy for *laurae* plus *edenticulata*. The denticles or cusuples seem to be modified spines (macrosetae) and although they might vary in shape from one species to another, they all seem to share two common features: they are fairly thick (compared to other spines in the cymbium) and pointed at the distal end, and they have longitudinal striae (Figures 68–70, 111, 324). *Pimoa cthulhu* presents an autapomorphic secondary cymbial process that more or less shares its base with the denticulate process, but is relatively ventral to it. This secondary process has a very conspicuous group of thick and long spines in its distal half; its proximal half is densely covered with setae (Figures 85, 87, 89, 91, 107). On the cymbium of *curvata* a large and complex, heavily sclerotized projection is found, in a relatively dorsal position to the denticulate process. The anterior distal end of this process is twisted and covered on its posterior side with several rows of small spines, denticle-like, but different from those of the typical denticulate process (Figures 368–370, 387, 389). These secondary cymbial projections in *cthulhu* and...
Curvata are probably not homologous, because they do not meet the criteria of position and special similarity.

Pimoids share the presence of a sclerite on the ventral side of the cymbium, anteroectal to the distal margin of the alveolus (Figures 46, 54, 303). The sclerite can be seen best when the cymbium is dissected apart from the basal haematodocha; then it appears as a dark sclerotized plate that lies between the distal end of the alveolus and the membranous attachment of the PCS on the ventral side of the cymbium. The distal margin of this sclerite can be seen in an unexpanded palp from a ventral and/or anterior view (Figures 43, 44, 156). It is particularly large in curvata (Figure 368). I have not been able to find a homologous structure in the palp of other araneoids and it seems to be synapomorphic for pimoids.

**Character 4:** Pimoinae cymbial sclerite (PCS). 0: absent; 1: present.

**Character 5:** PCS connection to the cymbium. 0: sclerotized and rigid (rupicola, Figure 17); 1: membranous and flexible (hespera, Figure 130).

**Character 6:** PCS membranous ridge. 0: absent; 1: large (breuili, rupicola, Figures 44, 16); 2: small (chthulhu, Figure 87).

**Character 7:** PCS conformation. 0: U-shaped in ectal view (breuili, Figure 44); 1: more or less elongated antero-posteriorsly and parallel to the cymbial margin in dorsal view (altioculata, Figure 304); 2: T-shaped in ventral view (hespera, Figures 126, 130); 3: reversed-J shaped in ventral view (sinuosa, Figure 256).

**Character 8:** Relative length of the branches of the T conformation PCS, as seen in ventral view. 0: unequal (hespera, Figures 126, 130); 1: equal length (haden, Figure 156).

**Character 9:** PCS distal branch. 0: short; 1: long and distally projected (edenticulata, Figure 411).

The presence of the PCS (character 4) is synapomorphic and diagnostic for the pimoids, as all of the known species have it and its presence is restricted to this clade. So far I have not been able to identify a structure homologous to the PCS outside the pimoids. The characters that are present only in the ingroup (therefore there is not a character state for them in the outgroup), e.g., the PCS cannot be polarized by outgroup comparison by themselves. They are polarized based on those characters that are represented in both the outgroup and the ingroup and optimized in such a way that they add no extra length to the cladogram. In other words, the rooting of such transformation series is based on the character that present states in both the ingroup and the outgroup and therefore can be polarized by outgroup comparison. By examining the resulting optimizations on the cladogram we can infer primitive and derived states for the mentioned characters. In a ventral view of the palp the PCS is positioned on the ectal margin of the cymbium, between the paracymbium and the cymbial denticulated process. As I already mentioned, in Pimoa breuili, P. rupicola, and P. cthulhu (Figures 43–45 and 54, 15–17, and 88–91, respectively) the base of the PCS is non-membranous and continuous with the paracymbium (character 5), whereas in the rest of pimoids the PCS is attached to the ventral side of the cymbium by means of a membrane (e.g., jellisoni, in Figure 190). According to the hypothesis of relationships suggested by the preferred cladogram (Figure 442) a sclerotized and rigid connection of the PCS (character 5) is the plesiomorphic condition. The membranous connection of the PCS is inferred to be synapomorphic for all pimoids except the three most basal taxa. Pimoa breuili, P. rupicola, and P. cthulhu share the presence of a sclerotized membranous ridge of the PCS (character 6), somewhat smaller in the latter species (Figures 15–17, 43–45, and 87, 88, respectively). The overall conformation of the PCS varies (character 7) across taxa: Pimoa breuili, P. rupicola, and P. cthulhu have the PCS (as seen from an ectal view of the palp) more or less U-shaped (Figure 44). In the Asian taxa the PCS is seen in the ventral view as a reversed J (Figures 218, 233, 256); in the hespera clade it is seen as an inverted T (Figures 130, 190), the branches being of equal length in haden (character 8). Finally, curvata, laurae, and edenticulata are characterized by the presence of a long and projected distal branch in the PCS (character 9; Figures 368, 392, 411). On the basis of the preferred phylogeny (Figure 442) the non-membranous connection of the PCS, the U-shaped conformation, and the presence of a sclerotized ridge are plesiomorphic states for the pimoids, and are present exclusively in the three most basal taxa.

**Character 10:** Paracymbium attachment. 0: integral (i.e., continuous with the cymbial margin, as in hespera, Figure 130); 1: intersegmental (Leptophyantes).

**Character 11:** Paracymbium morphology. 0: straight (Tetragnatha); 1: U-J shaped (Linyphia); 2: fused to PCS and linguiform (breuili); 3: triangular (hespera); 4: short and procured (crispa); 5: large and distally pointed (Zygilla x-notata); 6: Stemonyphantes type; 7: small bump (nematoide).

**Character 12:** Paracymbium apophyses. 0: absent; 1: present.

The pimoid paracymbium appears as a lateral projection of the base of the ectal margin of the cymbium (character 11). Millidge (1988) has named this type integral paracymbium. Although its morphology might vary, it is never attached to the cymbium by means of a membrane (intersegmental, if Millidge's terminology is preferred) as it is the case in most linyphiids. The integral paracymbium appears to be the plesiomorphic condition for araneoids. Intersegmental paracymbia are found only in the Linyphiidae and in some tetragnathids (e.g., Pachygnatha and Tetragnatha (Levi, 1981:274, 286)), but these conditions probably arose independently. Pimoa breuili, P. rupicola, and P. cthulhu have a linguiform paracymbium, relatively long and continuous with the base of the PCS (Figures 45, 17, and 89–91). In other words, in the mentioned taxa the ectal margin of the cymbium gives rise at its base to the paracymbium, and more distally to the PCS. If the cladogram presented in Figure 442 is accepted,
the linguiform paracymbium connected to the PCS would represent the primitive state for pimoids and its occurrence is restricted to the three most basal taxa. The known males of the rest of the North American pimoids have a more or less triangular paracymbium (Figures 130, 158). In the Asian taxa (except nematoide) the paracymbium is shorter and more or less procurved at its distal end (Figures 221, 234). In nematoide (although being relatively short and modified) there is a long and narrow sclerotized area of the cymbium between the ectal cymbial margin and the anterior paracymbial margin (Figures 285, 286). Linyphiids (except Stemonyphantes) have been coded as having the same overall paracymbium morphology, with a proximal and a distal paracymbial branch of varying length and more or less U-J shaped (character 11, state 1). In Stemonyphantes the paracymbium is a more or less flat plate, roughly U-shaped and attached by a membrane both to the cymbium and the tibia-cymbium intersegmental membrane; this is considered by Millidge (1988) as an intermediate form between the integral and intersegmental types. Overall paracymbial morphology variation is very difficult to interpret and to code, resulting in the character with the largest number of states in the matrix.

Character 13: Tegular suture: 0: conspicuous (breuili, Figure 43); 1: subtle or absent (altiicolata, Figure 301).

In pimoids the tegulum is seen in a ventral view of the palp as a more or less smooth and rounded surface that bears a series of apophyses and processes. On the tegulum there is a suture, which I call the tegular suture (character 13), that runs from the anteroectal towards the posterior mesal margin (or anterior towards posterior in rupicola, Figure 15) and divides the tegulum into an anterior and a posterior region. However, in the most distal clades the suture disappears or is very lightly marked (e.g., in laurae, Figure 392). The primitive condition is inferred to be the presence of a well-defined suture and an anterior and posterior tegular regions. The reduction and loss of this suture would then be the apomorphic condition. The posterior tegular region has in many instances a more or less pronounced bump, particularly conspicuous and pointed in gandhii (Figure 218). The ejaculatory duct, coming from the tegular bridge, runs close to the tegular margin, making a loop in the posterior tegular region just before entering into the PEP-embolus base (Figures 9, 10, 373). Pimoids lack the linyphiid suprategulum (character 15).

The subtegulum is connected to the cymbial alveolus by means of a basal hematodocha. A more or less lightly sclerotized structure, the petiole, anchors the subtegulum to the ventral side of the cymbium. The petiole is fused to the internal side of the subtegulum (i.e., facing the alveolus), but can be only seen in the expanded palp (Figures 9, 10, 311). The subtegulum is a ring-shaped sclerite, connected to the tegulum by means of a membrane and by a sclerotized bridge (Figures 9, 10) that I call tegular bridge (although it is in fact a tegulum-subtegulum connection). The ejaculatory duct runs from the subtegulum into the tegulum through the tegular bridge. The fundus is located in the subtegulum, at the base of the tegular bridge (Figures 9, 10; note that these two figures are schematic, and in fact the tegular bridge has been illustrated slightly larger for clarity purposes).

Character 14: Mynoglenine tegular apophysis. 0: absent; 1: present (Haplinis).

Character 15: Suprategulum. 0: absent; 1: articulated (with a hinge; Stemonyphantes); 2: continuous with the tegulum (i.e., not articulated; Lephyphantes). The suprategulum is absent in pimoids.

Character 16: Median apophysis. 0: present (breuili, Figure 66); 1: absent.

Character 17: Conductor. 0: present (breuili, Figure 66); 1: absent.

On the anterior tegular division two structures are found in almost all the pimoids, closely associated one to each other and located near the tegular suture: a membrane (character 17) and a small hook-shaped apophysis (character 16). On the tegular membrane rests the distal end of the embolus, and it seems logical to hypothesize that the embolic membrane serves the function of protecting the delicate distal end of the embolus, where the ejaculatory orifice is (Figures 66, 67). I have regarded this tegular membrane as homologous to the araneoid conductor. The tegular membrane varies in size and morphology (character 18), and it is frequently covered with small cuticular denticle-like projections (Figures 67, 106, 216, 217). This membrane is present in all the pimoids that I have examined, although there are some, presumably independent, cases of reduction (e.g., in petita and sinuosa; Figures 340 and 256, respectively). I have homologized the tegular hook (character 16) with the araneoid median apophysis. The pimoid median apophysis has been independently lost in the breviata clade and in cthulhu, otherwise it is present in the rest of the pimiod species I have examined, with a more or less similar morphology but varying in size. Both the median apophysis and the conductor are positioned very close to each other (Figures 214, 215; the homology of the conductor and the median apophysis are discussed in detail in the “Cladistics” section).

Character 18: Conductor morphology. 0: small and undivided (altiicolata, Figure 321); 1: large and bilobate (curvata, Figure 388).

Character 19: Distal end of conductor. 0: unmodified; 1: with a hook-like projection (jellisoni, Figure 214).

Character 20: Embolus length. 0: long and filiform (altiicolata, Figure 310); 1: short (Lephyphantes). In the pimoids the embolus is always filiform and more or less long. The presence of a distal twist in the embolus (character 21) is synapomorphic for sinuosa and nematoide (Figures 256 and 287, respectively). A long and filiform embolus also occurs in cthulhu (Figure 85) but presumably it appeared independently.

Character 21: Distal end of embolus. 0: straight (breuviata, Figure 345); 1: with distal twist (sinuosa, Figure 256).

Character 22: Embolic membrane (defined as an outgrow
of the column). 0: absent; 1: present (Linyphia).

Character 23: Pimoid embolic process (PEP). 0: absent; 1: present (Figures 9, 10). The most conspicuous structure on the pimoid tegulum is the pimoid embolic process, which is diagnostic and synapomorphic for the pimoids. The PEP is a long tegular projection that parallels the tegular margin (as well as the embolus in many cases), ending on the posterior tegular margin, more or less in the proximity of the conductor, median apophysis, and PCS connection to the cymbium (e.g., in hespera, Figure 130). Although the PEP morphology and relative position vary across taxa (characters 24-26), it is always connected to the posterior tegular division. In those species without a tegular suture (or with an inconspicuous tegular suture) the PEP occurs either on the posterior tegular margin, more or less in the proximity of the conductor, median apophysis, and PCS connection to the cymbium (e.g., in edenticulata, Figure 410) or on the ectal region (e.g., nematoide, Figure 287). The plesiomorphic condition is inferred to be a bifurcated and more or less filiform PEP (rupicola and breuili, Figure 10), and wide and lamelliform non-bifurcated PEPs probably represent the derived state (e.g., curvata, Figure 371). The PEP in breuili is particularly complex, bearing several apophyses on the bifurcation (Figure 47). I have not found a homologous structure to the PEP in other araneoids.

Character 24: PEP conformation. 0: undivided (crispa, Figure 233); 1: with secondary branch (breuili, Figure 10).

Character 25: PEP apex. 0: non-rolled (crispa, Figure 233); 1: rolled or twisted (jellisoni, Figure 192).

Character 26: PEP base. 0: narrow (breuili, Figure 48); 1: wide and lamelliform (curvata, Figure 371).

Character 27: Length of the embolus, in relation to the PEP (the length is measured from the embolus-PEP connection towards the distal end). 0: embolus shorter than the PEP (breuili, Figure 43); 1: embolus and PEP of roughly the same length (breviata, Figure 346); 2: embolus longer than the PEP (sinuosa, Figure 256).

The pimoid embolus is closely associated with the PEP, sharing a common base through which the ejaculatory duct runs (e.g., curvata, Figures 373, 374), although its length relative to the PEP varies (character 27). The plesiomorphic state for the embolus length is to be shorter than the PEP, as is the case in breuili (Figures 10, 43). Pimoa breviata is autapomorphic in having the embolus and the PEP of roughly the same length (Figure 346).

Character 28: Radix. 0: absent; 1: present.

Pimoids lack the radix that can be found in linyphiids and araneids, and therefore the characters that describe the radix and the radical apophyses (characters 31, 32) have to be scored as “non applicable” for pimoids.

Character 29: Column (distal haematodocha in Araneidae). 0: absent; 1: present.

Character 30: Fickert’s gland. 0: absent; 1: present.

This structure can be seen as a more or less globular enlargement of the sperm duct in the radix of some linyphiids.

Character 31: Terminal apophysis. 0: absent; 1: present.

The terminal apophysis is a radical structure located near the base of the embolus of some linyphiids.

Character 32: Lamella characteristica. 0: absent; 1: present (Leptyphanses).

The lamella characteristica is a sclerite of the linyphiid embolic division, located in the posterior part of the radix, adjacent and anterior to the terminal apophysis.

Character 33: Tibial apophysis in male pedipalp. 0: absent; 1: dorsal and rounded (cthulu, Figure 87); 2: dorsal and conical (jellisoni, Figure 193); 3: retrolateral (Walckenaeria); 4: ventral and hooked (Stemonyphantes). The distal end of the male palpal tibia of pimoids has a dorsal apophysis or protuberance that varies in size and shape. The presence of this dorsal apophysis (character 33) is a synapomorphy of pimoids. The preferred cladogram (Figure 442) suggests that this apophysis is neither homologous to the retrolateral tibial apophysis of erigonines, nor to the ventral tibial apophysis of Stemonyphantes: when optimized on the cladogram it requires three independent origins (in erigonines, in Stemonyphantes, and in pimoids). The plesiomorphic state in pimoids is a more or less rounded apophysis (e.g., cthulu, Figure 87). The conical and pointed apophysis of haden and jellisoni (Figure 193) are regarded as apomorphic. An elongated tibia (longer than twice its width) is synapomorphic for the hespera clade (Figure 131); a similarly elongate palpal tibia is predicted for mono in which the male remains unknown. The presence of a row of dorsal spines in the distal end of the tibia (character 34; Figure 347) is a synapomorphy of the breviata clade.

Character 34: Male pedipalp tibial spines. 0: not clustered; 1: in a distal row (breviata, Figure 347).

Character 35: Number of trichobothria in prolateral tibial margin of male pedipalp. 0: one; 1: three or more; 2: two.

Character 36: Number of trichobothria in retrolateral tibial margin of male pedipalp. 0: two; 1: four; 2: three; 3: five or more. The number of prolateral and retrolateral trichobothria in the male pedipalpal tibia (characters 35 and 36 respectively) characterizes the hespera clade within the pimoids, by having a larger number of trichobothria than in most of the rest of pimoids. These characters are meaningful only in the context of pimoids, and when scored for a larger suite of taxa (i.e., at a higher level) they seem to be uninformative.

Character 37: Male palp trochanter. 0: smooth; 1: with apophysis (altioculata, Figure 307).

FEMALE GENITALIA

Female genitalic characters provide diagnostic features for the species identifications, as well as information for the study of the phylogenetic relationships. I shall describe first the general morphology of the female pimoid genitalia and then the modifications of it. The groundplan for the female pimoid genitalia consists of an evagination of the abdominal wall made of a dorsal (posterior) and a ventral (anterior) plate. The ventral
and dorsal plates of the epigynum contact each other by a fold or suture that I have called the epigynal fold (character 39), as well as by the distal end (which is something like a hinge between the dorsal and ventral plates). The copulatory openings are located at the distal end of the epigynal fold. The copulatory duct is partially located at the epigynal fold (at least the initial part, which is in fact the more or less tubular space that the dorsal and ventral plates leave in between them). The copulatory duct opens into a more or less spherical spermatheca. The spermathecae are connected to the uterus externus by short fertilization ducts, which are associated with the proximal end of the dorsal plate. In several species (e.g., *indiscreta*) the spermathecae present an accessory chamber, which runs in a dorsoventral direction and originates from both the base of the spermatheca, sensu stricto, and the base of the fertilization duct. The fertilization ducts do not offer any significant morphological variation across the pimoids.

**Character 38:** Epigynum form. 0: protruding less than its width (*rupicola*, Figure 29); 1: protruding more than its width (*curvata*, Figure 377).

**Character 39:** Epigynal fold. 0: dorsal (*altioculata*, Figure 313); 1: lateral (*crispa*, Figure 240). Most of the pimoids have dorsal epigynal folds (e.g., *altioculata* in Figure 313) but the *gandhii* group have them in lateral position (e.g., *indiscreta* in Figure 250). The dorsal epigynal folds are considered to be the plesiomorphic condition.

**Character 40:** Epigynal ventral plate. 0: unmodified; 1: “humped” (in lateral view) and lip-like (in posterodorsal view; *hespera*, Figure 138); 2: pointed (in lateral view, *mephitis*, Figure 431).

**Character 41:** Epigynal plate margins. 0: thin; 1: swollen and lip-like in lateral view ("labiate"; *gandhi*, Figure 225).

**Character 42:** Position of the dorsal plate. 0: external; 1: internal (i.e., covered by the ventral plate, as in *vera*, Figures 118–120). *Pimoids vera* and *P. cthulhu* share a special conformation of the epigynum: it is very long and cylindrical, the ventral plate leaving an elongated opening on the dorsal side of the epigynum; at the base of this opening can be seen the base of the dorsal plate (Figures 95 and 119) that otherwise is covered by the ventral plate.

**Character 43:** Dorsal plate. 0: without projections; 1: with short projections (curvata, Figure 382); 2: with long projections (laurae, Figure 396).

**Character 44:** Opening of the epigynal ventral plate. 0: unmodified; 1: shaped as keyhole (*jellisoni*, Figure 196).

**Character 45:** Copulatory ducts. 0: discrete (i.e., non fused); 1: fused (*indiscreta*, Figure 251). The fusion of the proximal (basal) part of the copulatory ducts has occurred in *gandhii* and *indiscreta* (Figures 228 and 251, respectively). Discrete copulatory ducts is inferred to be the primitive condition.

**Character 46:** Copulatory duct length. 0: longer than the spermatheca width (*cthulhu*, Figure 94); 1: shorter than the spermatheca width (*hespera*, Figure 141).

**Character 47:** Copulatory duct double twist. 0: absent; 1: present (*sinuosa*, Figure 272). The plesiomorphic state is to have a single twist in the copulatory duct (e.g., *rupicola*, Figure 32). The twist has been lost in the *breviata* clade (Figure 378). There are more than one twist in the copulatory ducts of *anatolica* and *sinuosa* (Figures 297, 272).

**Character 48:** Atrium (as defined in Blauvelt, 1936). 0: absent; 1: present (*Linphyia*).

**SOMATIC MORPHOLOGY**

**Character 49:** Mynoglenine cephalic sulci. 0: absent; 1: present.

**Character 50:** Tracheal system. 0: haplotracheate (*altioculata*); 1: desmitracheate (*Erigone*). Both terms are used sensu Millidge (1984). Within the pimoids, tracheal system dissections were done for *altioculata*, *breulli*, *cthulhu*, *jellisoni*, and *breviata*. In all cases they were found to have an haplotracheate system, the atrium opening by means of a single spiracle. The tracheal system was inferred not to vary across species in the pimoids, and was scored with the same state for all the species (although only five were actually dissected and studied). Detailed descriptions of the tracheal anatomy of linyphiids are provided in Hormiga (in press).

**Character 51:** Dorsal pattern of abdomen. 0: otherwise; 1: two light chevrons on a dark gray background (*sinuosa*, Figure 269). The pattern of abdominal pigmentation varies across species, although all the pimoids have a common general pattern. This general dorsal abdominal pattern consists of a more or less dark background color (black-dark gray or dark brown) with lighter (very light brown or whitish color) marks (Figures 134, 230). There is a substantial degree of intraspecific variation in the pattern, as well as in the overall degree of pigmentation of the individual specimen (e.g., *Pimosa altioculata* in Figures 305, 306, 318, 319). Different individuals of the same species might have different abdominal patterns, and/or different overall degree of pigmentation (light vs. dark individuals). This variation might not be strictly geographical, because individuals from the same locality and date of collection can vary in their pattern. I have illustrated and described (at least partially) the variation of the abdominal pattern, but in most of the cases this pattern cannot be used alone by itself for species identifications. *Pimosa cthulhu* (Figure 99) presents an abdominal pattern consisting of only four relatively small light marks; such reduction is autapomorphic for this species. In *indiscreta* and *anatolica* the abdominal pattern has two conspicuous light chevrons (character 51; Figures 254 and 295, respectively).

**Character 52:** Prolateral surface of male chelicera. 0: smooth; 1: with stridulatory striae (*altioculata*, Figure 326). Pimoids share with most of the linyphiids the presence of stridulatory striae on the ectal side of the chelicera (Figures 326, 75). Presumably vibrations are produced by friction of the enlarged setal bases (found on the base of the prolateral side of
the pedipalp femur, Figure 366) against the cheliceral striae. The presence of this type of stridulatory organ provides support for the monophyly of pimoids plus linyphiids, as Wunderlich (1986) suggested.

**Character 53:** Number of retrolateral teeth in female chelicera. 0: four or more; 1: two; 2: three.

The number cheliceral teeth has been a classical character in species descriptions, although its value for phylogenetic inference may vary from case to case. Three prolateral teeth is invariant across the pimoids, but the number of retrolateral teeth does vary across species. The number of retrolateral teeth in the female chelicera was studied for most of the pimoids and the linyphiids. It has been studied in the females because in six pimoid species only the females are known, while two species are known only from the males (a total of eight out the 21 known species of pimoids are known for only one of the sexes). Female pimoids have either two (e.g., *rupicola*) or three retrolateral cheliceral teeth (e.g., *hespera*); the sample of linyphiids represented in my dataset have four or more retrolateral teeth. Intraspecific variation exists in this trait (for example in *breuili* it varies from two to three). In the outgroups of my study (*Tetragnatha* and *Zygia*) the number was three, but other taxa in the same families (and probably even in the same genera) might have a different number of retrolateral cheliceral teeth. So the polarity decision for this character is linked to the specific choice of the exemplars for the outgroups (see discussion in the “Cladistics” section).

**Character 54:** Female pedipalp tarsus. 0: with claw; 1: without claw.

**Character 55:** Leg autospasy at the patella-tibia junction. 0: absent; 1: present.

Pimoids share with linyphiids the autospasy of legs at the patella-tibia junction. This is unique among araneoids (Roth and Roth, 1984:142) and therefore is a synapomorphy for the linyphiid-pimoid clade, as Wunderlich (1986) suggested. Autospasy and its distribution across major spider groups was reviewed by Roth and Roth (1984). However, detailed information about the anatomical and physiological bases of autospasy is lacking and we are limited to report it as a mere absence/presence, without a real understanding of it. Although it might be easy to propose hypotheses about its possible adaptive value (e.g., to facilitate escaping from predators), it is not clear why some spiders do not exhibit any autospasy at all (e.g., most haplogynes, Roth and Roth, 1984:140).

**Character 56:** Male Femur I midthird. 0: few spines (less than 10), not clustered; 1: with group (10 or more) of stout spines (*altioculata*, Figure 309). Spination patterns exhibit a great degree of intraspecific variation and even “intraindividual” variation (differences between the number of spines in the right and left sides of the body). For example, the holotype of *breviata* has on its left femur I four dorsal and four prolateral spines, while the right one has two dorsal and two prolateral. The total range for 12 specimens of *breviata* in which I recorded the spination of the femur I was dorsal two to five, and prolateral two to five spines for the whole sample. Similar ranges of variation were found in other species. The phenotypic expression of both the spination and the setal patterns could have a large environmental component. Because of its variability, spination patterns are not reported in the descriptions unless they offer diagnostic features, as for example in the case of the basal femoral cluster of *sinuosa* (Figure 265). It is interesting to note that pimoids have two spines on the dorsum of the fourth tibia, as many as the “linyphine” linyphiids do. This provides explicit outgroup evidence for considering plesiomorphic the presence of two dorsal spines on tibia IV, a classical character used to define (or at least diagnose) the linyphiines. For example, van Helsdingen (1986:122) when analyzing the affinities of myogenelines pointed out that “Linyphiinae as a rule bear two dorsal spines on tibia IV.” Because two dorsal spines on tibia IV is the plesiomorphic condition, its presence in other linyphid taxa does not provide evidence for monophyly. A single dorsal spine on tibia IV or absence of dorsal tibial spines (as in many erigonines) is therefore apomorphic within linyphiids.

Many pimoids (but not all) have extremely long setae covering the legs, particularly the tibia, metatarsus, and tarsus, e.g., in *Pimoa breuili* and *P. chulhu* (Figures 76, 98). However, this trait varies intraspecifically. For example, some specimens of *rupicola* are densely covered with long setae, while others lack them almost completely. Although in some cases the absence of the characteristic long setae might be a preservation artifact, in others it is clearly not.

**Character 57:** Metatarsus IV trichobothrium. 0: present; 1: absent.

The presence/absence of the trichobothrium of the metatarsus IV and the position of trichobothrium of the metatarsus I are classical characters in linyphiid systematics. In most pimoids the trichobothrium is located in the distal third of the metatarsus. However, its position varies in what seem to be the most basal pimoid taxa. The european taxa (*breuili* and *rupicola*) have it in the medial third, and *chulhu* is autapomorphic in having a large number of metatarsal trichobothria in a row (in the metatarsus I it varies from 7 to 11 in the male, and from 8 to 10 in the female). Most of the linyphiids in the data set have it in the proximal third but *Novafroreta*, and the erigonines *Erigone* and *Walckenaeria* have it in medial position. *Haplinis* has a row of 4 or 5 metatarsus I trichobothria. The relative position of the trichobothrium is described as a ratio (e.g., in *Millidge*, 1980:105) and has a continuous range of values. Therefore the use of relative positions of trichobothria presents many of the coding problems of continuous characters, although this is only a methodological drawback. I do not think that the study of the relative position of trichobothria across wide ranges of taxa provides clear evidence of recency of common ancestry. It is often the case that this character varies widely within some genera, as pointed out by Holm (1984) for *Walckenaeria*. Although I have documented the position of the trichobothrium
of the metatarsus I in the pimoids, I have not used it in the cladistic analysis for the above mentioned reason. The trichobothrium of the metatarsus IV is present in all pimoids.

SPINNERET SPIGOT MORPHOLOGY

Pimoids exhibit a pattern of spinneret morphology consistent with the araneoid groundplan (see Coddington, 1989), although it has some unique features. Linyphiids and pimoids share the position of the mesal cylindrical spigot on the PLS. This spigot is located on the periphery of the PLS (Figure 146), however this is not exclusive of linyphiids and pimoids. A similar location was already known for some tetragnathids (Coddington, pers. comm.; Platnick et al., 1991). Examination of Zygia x-notata (the affinities of Zygia are problematic: Zygia is either sister to Araneidae, i.e., it is the most basal currently it is placed in Tetragnathidae, formerly it was placed ton, pens, comm.; Platnick et al., 1991). Examination of Zygia x-notata (the affinities of Zygia are problematic: Zygia is either sister to Araneidae, i.e., it is the most basal currently it is placed in Tetragnathidae, formerly it was placed...)

...the araneine clade; Scharff, pers. comm.) shows that the mesal position of this is not exclusive of linyphiids and pimoids. A similar relationship by J. Coddington and N. Scharff suggest that Zygia is either sister to Araneidae, i.e., it is the most basal taxon within araneids, or sister to Araneinae, i.e., basal within the araneine clade; Scharff, pers. comm.) shows that the mesal cylindrical spigot on peripheral position might be more widespread than initially thought, because it occurs in some taxa of at least three araneoid clades: the araneids, tetragnathids, and the linyphiid-pmoid clade. Pimoids and linyphiids lack the PMS anterior aciniform brush found in many primitive orbicularians, but the brush is also absent in many other taxa (e.g., tetragnathids and theridiids).

**Character 58:** PLS mesal cylindrical spigot base. 0: same size as ectal; 1: enlarged (larger than the other cylindrical spigot base) (hespera, Figure 146). A relative enlargement of the base of the peripheral cylindrical spigot of the PLS is found in pimoids and linyphiids, the base is larger than the base of the other cylindrical on the PLS (Figures 116, 146). This synapomorphy provides additional support for the sister group relationship of pimoids and linyphiids. The difference in size between the two PLS cylindrical spigots seems to be more conspicuous in the linyphiids that I examined than in the pimoids.

**Character 59:** Aciniform spigots on female PMS. 0: more than one; 1: one; 2: absent.

**Character 60:** Aciniform spigots on female PLS. 0: more than one; 1: one; 2: absent.

Pimoids are unique in having a drastic reduction of the PMS and PLS aciniform fields: they either have one or none aciniform spigots for each spinneret. This synapomorphy provides further support for the monophyly of pimoids. Although the loss of all the aciniform spigots is a very rare event, it has also occurred in the linyphiid genus Stemonyphantes (this loss has presumably occurred independently). The number of aciniform spigots on both the PLS and the PMS (characters 59 and 60, respectively) has been scored for the females of all the pimoids. Three meristic patterns were found for the distribution of aciniform spigots in pimoids: one aciniform on the PLS and one on the PMS (e.g., cthulhu), one aciniform on the PLS and none on the PMS (e.g., sinuosa), and no aciniforms on either spinneret (e.g., hespera). However, at least one of these two characters exhibits intraspecific variation: individuals of breuili might present one aciniform spigot on the PMS or none (Figures 82 and 80, respectively). The individuals that lack the mentioned spigot have instead a nubbin in its place, presumably the vestigial remnant of the lost aciniform spigot. I have not investigated in detail the intraspecific variation of this character across taxa, and although I have scanned more than one individual in several species, only in the case of breuili did I find variation. Peters and Kvoor (1991, their table 1) have reported a small range in the variation of the number of aciniform spigots on the PMS and PLS of Linyphia triangularis. Linyphiids have elongated aciniform fields on the female PLS.

**Behavior**

**Character 61:** Male position during construction of spermweb. 0: above spermweb; 1: below spermweb (from van Helsdingen, 1983).

**Character 62:** Male position during ejaculation. 0: above spermweb; 1: below spermweb (from van Helsdingen, 1983).

**Familial Placement, Cladistic Analysis, and Phylogenetic Relationships of the Pimoids**

The familial placement of the pimoids has remained controversial during many decades, as is evident from their taxonomic history. The initial placement in the linyphiids was never explicitly justified, not even at the generic level. The linyphiid genus Labulla, where several pimoids were initially placed, is clearly a "tailor's drawer" where different scraps are put together, regardless of their origin. Although I have examined only some of the species placed in Labulla, I have not found any with the exception of L. flahaulti Simon, and perhaps L. impudica Denis, that is clearly congeneric with the type species (Labulla thoracica Wider). "L." contortipes Karsch is not a linyphiid, the Hawaiian "L." graphica Simon probably require a new genus, and "L." torosa Simon probably require a new genus, and "L." grisea Schenkel, described from China, has been recently transferred to the genus Stemonyphantes (Tanasevitch, 1989). Evidently the criterion followed by many arachnologists for such placements has been quite broad and vague: similar overall somatic morphology and color pattern, and a "complex" palp morphology. One wonders how many more similar cases are to be found in linyphiid taxonomy.

The particular combination of derived and primitive character states present in the pimoids has caused its chaotic shifting from one group to another, depending on the characters that were taken into consideration. Their overall somatic and palp morphology vaguely suggested a tetragnathid placement (e.g., Fage, 1931; Thaler, 1976), close to the metines, particularly because the palp morphology seemed to be very different from
that of the linyphiids (paracymbium continuous with the
cymbium (integral), absence of the typical linyphid embolic
division). However, none of those placements was clearly and
explicitly documented with shared apomorphies. Crawford
(1988:23) noted that the conformation of the male palp of
Pimoa is “nearly identical to that of Chrysometa [Tetragnathidae],
including the distinctive cymbial apophysis.” A detailed
examination of the palp in both genera shows that they are not
so identical. The paracymbium of Chrysometa is “a separate
sclerite broadly attached to the cymbium” (Levi, 1986:102),
and therefore quite different from that of Pimoa. The cymbial
apophysis is also different in both genera; the PCS is an
independent sclerite in most of the pimoid species, and not an
apophysis. If the suggested homology is between the cymbial
process and the pimoid CDP, the differences are also notable.
Chrysometa’s palp conformation falls well into the metine
general conformation (e.g., Meta and Metellina, see also
Coddington, 1990a:16), including the presence of a conductor
and the “terminal apophysis” (the Metine Embolic Apophysis
or MEA of Coddington, 1990a). There is some similarity
between the PEP and the MEA of Chrysometa, but the
conductor is quite different, being a free sclerite in Chrysometa.
The tegular morphology is also different, being more or less
globular in the pimoids contrary to the tegulum of Chrysometa.
The similarities in the palp morphology between Chrysometa
and Pimoa vanish when examined in detail.

The computer program Hennig86 (Farris, 1988) was used to
analyze the data set presented in Table 1. The multistate
characters (15 out of a total of 62 characters) were treated as
unordered. Five out of the 21 pimoid taxa were represented
only by females, and therefore a large number of cells in the
data matrix (those pertinent only to male characters) have a “?”
entry. Because of the way the operational algorithms in the
program treat missing entries, the presence of a large number of
those entries in the matrix can result in an enormous set of
equally parsimonious alternative solutions, some of them not
supported by the actual available data in the matrix (Platnick,
Griswold, and Coddington, 1991). Because of this effect I
performed my initial analyses excluding the “female taxa” from
the dataset, in an attempt to minimize the number of missing
entries. Later on I studied the effect of the inclusion of the
mentioned taxa in the matrix. Four out of five of the species
with unknown males have putative synapomorphies that
unambiguously group them in distal positions of the cladogram.
The inclusion of those mentioned four species in the
dataset does not have an effect on the number of equally
parsimonious cladograms produced. However the inclusion of
Pimoa mephitis produces a dramatic increase in the number of
alternative equally parsimonious solutions (using the heuristic
search option “m*;bb*;” produces 177 cladograms, of 119
steps and 0.71 and 0.87 consistency and retention indices,
respectively), because of the multiple possible placements of
this taxon. For that reason mephitis was excluded from the
dataset for subsequent analyses, and its relationships are
considered incertae sedis.

The implicit enumeration option (using the command “ie;”)
produced 15 equally parsimonious cladograms, with a length of
118 and consistency and retention indices of 0.71 and 0.87,
respectively. The same results are obtained by using the
heuristic search option implemented by the commands “m*;
bb*;.” For this dataset the latter option is over five hundred
times faster than the implicit enumeration option. The strict
consensus tree for the 15 initial cladograms (Figure 440) shows
where the conflicts are in the cladogram. There is a basal
trichotomy that involves Stemonyphantes, the rest of li-
nyphiids, and the pimoids. Except the mentioned trichotomy,
the rest of the linyphid cladogram is fully resolved. The
pimoid clade has a basal heptachotomy and a distal trichotomy
for anatolica, sinuosa, and nematoide. Based on the consensus
cladogram the pimoids can be initially divided into five
components (the cthulhu, hespera, breviata, alticulata, and
gandhii clades) plus two species (rupicola and breuili).
The different arrangements of these seven pimoid components
found in the 15 most parsimonious cladograms can be
summarized into three topologies (Figure 441). The different
alternative topologies for the pimoid section of the cladogram
are three rooting variations of the same network (Figure 441C).
In other words, the 15 cladograms produced by implicit
enumeration suggest the same cladic network for the
Pimoidae, and differ only in the position of the root (1, 2, and
3 in Figure 441C).

Two alternative topologies exist for the resolution of
linyphiids (Figure 441A,B), differing in the placement of
Stemonyphantes, which can either be sister to the rest of
linyphiids or sister to the pimoids. The three pimoid summary
topologies differ quite drastically in the relationships they
suggest. All of them have Louisfagea as polyphyletic. The
gandhii clade is suggested as a distal branch by two topologies
(Figure 441C, topologies 2 and 3) and as the most basal one
by a third topology (Figure 441C, topology 1). Although the
consensus tree might be useful to show the conflicts between
the different alternative hypotheses, it can be a poor hypothesis
of relationships, both from the parsimony and the information
content points of view. In this particular case in which there is
a single network for the pimoids, the strict consensus tree
produces a basal heptachotomy, failing thus to inform us of
what is only a problem of alternative rootings. The strict
consensus tree is 135 steps long, requiring then 17 extra
instances of homoplasy.

Successful character weighting (Farris, 1969; Carpenter,
1988) was used as implemented by Hennig86 to select a tree
from the initial suite of 15 cladograms. This procedure is based
on the concept of cladistic reliability, that is, the degree of fit
between the characters and the phylogeny (Farris, 1969).
Successful character weighting ascribes new weights to the
characters based on their consistency with the original set of
cladograms obtained. The weighting scheme implemented by
Hennig86 uses the product of the consistency index by the
The monophyly of pimoids plus linyphiids is supported by the following synapomorphies: autospasy at the patella-tibia junction, presence of stridulatory striae on the ectal side of (at least) the male chelicerae, and an enlarged and rounded base of the mesal cylindrical gland spigot in the PLS. The two first synapomorphies were already suggested by Wunderlich (1986). Additional support is provided by the absence of paracymbial apophyses, although this character reverses in the lephtypantines. The stridulatory striae are secondarily absent in Linyphia and Erigone, among several other genera. Wunderlich (1986) also suggested that additional support for the monophyly of pimoids and linyphiids was given by the presence in both clades of sheet webs. The way pimoids move upsidedown on the undersurface of the web is also congruent with linyphiids. I have studied the webs of several North American species (altiliicolata, brevistia, edenticulata, laurae, and cthulhu); Coddington (pers. comm.) has documented the same kind of web for sinuosa. Although the webs of ripicola and breuilii have not been documented it seems reasonable to assume that they do not differ significantly from the ones we know. To my knowledge, apart from linyphiids, only cyatholipids (and some synotaxids; C. Griswold, pers. comm.) make similar webs among araneoids. Based on the most recent estimates of Araneoidea phylogeny (Coddington, 1990a, 1990b) it seems quite reasonable to infer that sheet webs are apomorphic in araneoids. Whether the sheet web has evolved once or more is a question that cannot be resolved without resolving the problematic placement of cyatholipids.

The monophyly of the pimoids is unambiguously supported by the following putative synapomorphies: the presence of a cymbial denticulate process, the pimoid cymbial sclerite, the pimoid tegular-embolic process, and the presence of a dorsal rounded tibial apophysis in the male palp. The two first listed synapomorphies were already suggested by Wunderlich (1986). Griswold (1990:14) has suggested that the absence of palpal tibial processes is probably plesiomorphic for Orbiculariae, although there is some homoplasy in this character because it occurs in some anapids and many linyphiids. The denticles of the cymbial process are secondarily lost in edenticulata. Additional support for pimoid monophyly is provided by the reduction of the number of aciniform spigots in the PMS and PLS. The loss of all the aciniform spigots is an extremely rare event in araneoids, and to my knowledge it has not been documented before. But in spite of its rarity it has also occurred, presumably in parallel, in the linyphiid genus Stemonyphantes. Several equally parsimonious optimizations exist for the number of aciniforms on the PMS (character 59) on the preferred cladogram, but none of them can explain the data without re-appearance of the aciniform spigots after being lost. Furthermore, none of the 15 most parsimonious cladograms can explain the data without having the aciniforms gained, at one point or another, after being lost in the nearest ancestor. One of the possible optimizations in the preferred cladogram is to assign the total loss of PMS aciniforms to the common ancestor of pimoids and linyphiids, but that requires subsequently the gain of the aciniform fields in the rest of linyphiids after the Stemonyphantes node as well as in some pimoids. Because that seems to be a rare event, I have dismissed such optimization and preferred to map the changes where they first occur. For that reason I have preferred to interpret homoplasy regarding the loss of the PMS aciniforms in the sense of two independent events, occurring in parallel in Stemonyphantes and in the pimoids. In the case of the PLS aciniform spigots the data unambiguously support the loss in parallel in the higher pimoids and in Stemonyphantes.

Six of the 15 most parsimonious cladograms suggest Stemonyphantes as sister to the pimoids. I reanalyzed the data after inactivating the characters that refer to the number of aciniform spigots (characters 59 and 60). The "m*; bb*;" option of Hennig86 produced 102 parsimonious cladograms 109 steps long, with consistency and retention indices of 0.73 and 0.87, respectively. The strict consensus tree of the 102 cladograms supported the relationships (Pimoids (Stemonyphantes, Linyphiids)). So consideration of Stemonyphantes as sister of the pimoids seems to be based on the loss of the aciniform spigots, although that clearly contradicts the evidence provided by the palp morphology.

I have studied the spinneret spigot morphology and distribution for all the species of Pimoidae for which I had female specimens. When enough specimens were available they were photographed with the SEM. To my knowledge this is the first time that this morphological character has been exhaustively documented at the species level for a relatively large number of species within a monophyletic group. The character exhibits little variation within the generic level, but provides some grouping information. Deactivating the characters that account for the number of aciniform spigots provokes a substantial loss of resolution (i.e., many more equally
TABLE 1.—Character data for Figures 440–442. [Rows represent characters and columns taxa. The first state is "state 0," the second is "state 1," etc. Question marks represent missing data, and dashes "non applicable" states. The last two columns give the consistency index (CI) and the weight (WE) assigned to the character in the successive character weighting analysis (see text). Taxon (in the same order as in the matrix) abbreviations: Te = Tetragnatha versicolor, Zy = Zygiella x-notata, Li = Linyphia triangularis, Mi = Microtinea dana, Bo = Bolyphantes lateolus, Le = Lepthyphantes tenax, Er = Erigone psychrophila, Wa = Walckenaeria directa, Ha = Haplinis diloris, No = Novafromata vulgaris, St = Stemonyphantes blauveltae. The remaing taxa are species of Pimoa: ru = rupeicola, br = brevili, ct = cthulhu, ve = vera, mo = mono, he = hespera, ha = hadn, je = jellisoni, ne = nematoide, si = sinuosa, an = anatolica, in = indiscreta, cr = crispa, gy = gandhii, pe = petita, al = alticulata, bv = brevita, cu = curvata, ed = edenticulata, la = laurae (me = mephitus was excluded from the numerical analysis, see text).]

MALE GENITALIA

<table>
<thead>
<tr>
<th>Character</th>
<th>State 0</th>
<th>State 1</th>
<th>Consistency Index (CI)</th>
<th>Weight (WE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01. Cymbium morphology:</td>
<td>Yes</td>
<td>No</td>
<td>0.50</td>
<td>0.02</td>
</tr>
<tr>
<td>02. DDP denticles:</td>
<td>Yes</td>
<td>No</td>
<td>0.50</td>
<td>0.02</td>
</tr>
<tr>
<td>03. PCS:</td>
<td>Yes</td>
<td>No</td>
<td>0.50</td>
<td>0.02</td>
</tr>
<tr>
<td>04. Paracymbium attachment:</td>
<td>Yes</td>
<td>No</td>
<td>0.50</td>
<td>0.02</td>
</tr>
<tr>
<td>05. Paracymbium morphology:</td>
<td>Yes</td>
<td>No</td>
<td>0.50</td>
<td>0.02</td>
</tr>
<tr>
<td>06. Conductor:</td>
<td>Yes</td>
<td>No</td>
<td>0.50</td>
<td>0.02</td>
</tr>
<tr>
<td>07. Distal end of conductor:</td>
<td>Yes</td>
<td>No</td>
<td>0.50</td>
<td>0.02</td>
</tr>
</tbody>
</table>

This table continues with similar character states and their respective CI and WE values.
NUMBER 549

30. Fickert's gland: absent; present
31. Terminal apophysis: absent; present
32. Lamella characteristics: absent; present
33. Male pedipalp tibial apophysis: absent; dorsal, rounded; dorsal, conical; retrolateral; ventral not clustered; distal row
34. Male pedipalp tibial spines: not clustered; distal row
35. Prolateral trichobothria in male pedipalp tibia: one; three or more; two
36. Retrolateral trichobothria in male pedipalp tibia: two; four; three; five or more
37. Male palp trochanter: smooth; with apophysis

FEMALE GENITALIA
38. Epigynum form: protruding less than its width; protruding more
39. Epigynal fold: dorsal; lateral
40. Epigynal ventral plate: unmodified; "humped" with lip-like apical margin; pointed
41. Epigynal plate margins: thin; swollen and lip-like
42. Dorsal plate relative position: external; internal (covered by ventral plate)
43. Dorsal plate: without projections; with short projections; with long proj.
44. Opening of ventral plate: unmodified; keyhole shape
45. Copulatory ducts: separated; fused
46. Copulatory duct length: longer than spermatheca width; shorter
47. Copulatory duct double twist: absent; present
48. Atrium: absent; present

SOMATIC MORPHOLOGY
49. Mynoglenine cephalic sulci: absent; present
50. Tracheal system: haplotracheate; desmitracheate
51. Dorsal pattern of abdomen: otherwise; reduced to two light chevrons
52. Ectal surface male chelicerae: smooth; with striulatory striae
53. Retrolateral teeth female chelicera: four or more; two; three
54. Female pedipalpal tarsus: with claw; without claw
55. Patella-tibia autospasy: absent; present
56. Male femur I mid third: few spines, not clustered; cluster (10 or more) of spines
57. Trichobothrium metatarsus IV: present; absent

SPINNERET SPIGOT MORPHOLOGY
58. PLS mesal cylindrical gland spigot base: same size; enlarged
59. Aciniform gland spigots in female PMS: more than one; one; absent
60. Aciniform gland spigots in female PLS: more than one; one; absent

BEHAVIOR
61. Male position during construction of sperm web: above sperm web; below
62. Male position during ejaculation: above sperm web; below
parsimonious trees). In the PMS the aciniform spigots were presumably lost in the most recent common ancestor of pimoids (although as I previously noted, other equally parsimonious optimizations exist) and subsequently regained in two independent instances: in the \textit{cthulhu} clade and in the ancestor of the clade composed by \textit{sinuosa}, \textit{nematoide}, and \textit{anatolica}. The loss of the PLS aciniform spigots unambiguously supports the monophyly of the component that includes the \textit{hesperia}, \textit{gandhii}, \textit{atioculata}, and \textit{breviata} clades. The reappearance of this spigot supports the monophyly of the \textit{gandhii} clade with the exclusion of \textit{gandhii}. In contrast with the PMS, the optimization of the number of aciniforms on the PLS offers no ambiguity and the character requires a single homoplasious event.

Because no species was found with aciniforms on the PMS but not on the PLS, it is inferred that in the evolutionary history of the pimoids the aciniform spigots are first lost from the PMS, and when they are absent from the PMS they disappear from the PLS.

In summarizing our present knowledge of silk biology Coddington (1989) states that the aciniform gland silk is used for prey wrapping, retreating, and eggsacs. He also mentions that "aciniform spigots probably are mostly responsible for the threads used in prey-wrapping." Peters and Kovoor (1991:15) point out that "Araneidae use this (aciniform gland) silk, together with piriform fibres, for swathing prey (Peters, 1982). This swathing is very weak in \textit{Linyphia triangularis}, corresponding to the poor development of aciniform glands." If the aciniform spigots were the only ones responsible for the prey-wrapping we should not expect to find such behavior in the pimoids. That is not the case, at least if we assume the homology of this behavior across taxa. However, it has to be noted that prey-wrapping and wrap-attack are different behaviors. Coddington refers to the wrap attack when he discusses the use of the aciniform gland silk. Some prey-wrapping is probably primitive for all spiders, but that is different from the wrap-attack and bite complex present in Araneidae and Deinopoidea. I have observed prey-wrapping behavior in all the pimoids I have been able to observe in the field, that is \textit{atioculata}, \textit{breviata}, \textit{edenticula}, \textit{laurae}, and \textit{cthulhu}. All but the last mentioned species lack the aciniform spigots in both pairs of posterior spinnerets. \textit{cthulhu} has one in the PMS and one in the PLS. If prey-wrapping is a plesiomorphic feature of araneoids as Coddington (1989) suggests, and this behavior is homologous across araneoids, silk glands different from the aciniforms have to be involved in the production of silk used for prey wrapping. An alternative hypothesis is the non-homology of prey-wrapping in different araneoids, that is, the convergence on this behavior but with different silk glands involved in it in different taxa.

\textit{Pimoa rupicola} and \textit{P. breuili} are the two most basal taxa in the pimoids; they present many of the characters states that are inferred to be primitive for Pimoidea. The monophyly of all the pimoids with the exclusion of \textit{rupicola} and \textit{breuili} is unambiguously supported by three synapomorphies: a cymbial denticulate process with less than 20 denticles, the non-bifurcated PEP, and the presence of an epigynum protruding less than its width.

The male palpal and the epigynal morphology provide the majority of the characters for the resolution of the species phylogeny. Some characters are informative for only a small subset of taxa, while other characters might vary across a large number of taxa. An example of the latter is the paracymbium morphology (character 11), which varies widely. That results in a character coded as a large number of states, whose transformation series is difficult to hypothesize a priori. The character transformation series can be studied a posteriori from the inferred phylogeny. The pimoid paracymbium is continuous with the ectal margin of the cymbium ("integral paracymbium," sensu Millidge, 1988), and this is the plesiomorphic state for araneoids. The intersegmental paracymbium of linyphiids is therefore an apomorphic feature, as already has been suggested by many authors. By looking at the basal pimoids we can infer the plesiomorphic paracymbium morphology for the pimoids. \textit{Pimoa rupicola}, \textit{P. breuili}, and \textit{P. cthulhu} have a linguiform paracymbium, continuous with the PCS and this is inferred to be the primitive pimoid condition. This mentioned paracymbium is then transformed into a triangular paracymbium, with a wider base and independent from the PCS. The PCS connection to the cymbium becomes membranous and lightly sclerotized. In the \textit{gandhii} clade the paracymbium is procured and reduced in size.

I have interpreted the pimoid tegular membrane and the tegular hook, as a conductor and a median apophysis respectively. The presence of a median apophysis and a conductor on the tegulum is regarded as plesiomorphic for araneoids, the superfamily to which pimoids belong (Coddington, 1990a). However, for interpreting the median apophysis in pimoids it is crucial to know the outgroup condition for pimoids plus linyphiids, a problem still awaiting resolution. Two of the possible candidates are tetragenathids (lack the median apophysis) and araneids (usually have a median apophysis), but they do not unambiguously resolve the problem.

The conductor and median apophysis may be ontogenetically linked (Coddington, 1990a), and sometimes it might be difficult to say which one is which. Usually a functional criterion is then used, and the conductor is taken as the one that protects the distal end of the embolus (the intromittent section of the palp). However, the median apophysis has been lost in parallel in several clades; those absences are then considered as derived. In linyphiids for example, both the conductor and the median apophysis are absent.

On the pimoid tegulum two structures can be found: a membrane on which the tip of the embolus rests (Figures 10, 66), and a tegular hook-shaped projection (Figures 10, 66, and 214). Although these two tegular processes are positioned where the conductor and the median apophysis are in many araneoids, they are not particularly similar to the araneoid
conductor and the median apophysis. The tegular hook particularly fails to meet the criterion of special similarity because it lacks a membranous connection to the tegulum. For that reason, their nature has remained somewhat uncertain. In spite of their tegular position they have not been previously homologized to the conductor and median apophysis.

Two possible interpretations exist: the pimoid tegular hook can either be a novel sclerite or a sclerite homologous to the araneoid median apophysis. Both hypotheses might be equally parsimonious in terms of counting steps on a cladogram: loss of the median apophysis in the ancestor of pimoids and linyphiids, and gain of a new apophysis in pimoids (two steps) or modification of the median apophysis from its outgroup condition in pimoids and loss of the median apophysis in linyphiids (two steps). However, the non-homology hypothesis requires the loss of the median apophysis and the appearance de novo of another tegular sclerite in more or less the same position. Without any evidence for a novel sclerite I have preferred the alternative hypothesis because it seems more likely to postulate a transformation of the araneoid median apophysis than the gain of a new apophysis. However, the median apophysis has a very low consistency index (0.25) in my cladogram. Within the pimoids the median apophysis has been lost in parallel in the brevita clade and in P. cthulhu. Coddington (1990a) reported a 0.12 consistency index for the median apophysis in his study of Araneoidea palp morphology (the consistency index for his data set as a whole was 0.72).

Similarly, I have homologized the tegular membrane with the conductor. This homology is also supported by the presumed function of the pimoid conductor, i.e., the protection of the delicate apex of the embolus. Thaler (1976) considers the PEP as a conductor, implicitly suggesting homology to the araneoid conductor. I disagree with such homology because it seems to be based on functional criteria alone. In pimoids the embolus and the PEP share a common base through which the ejaculatory duct passes (e.g., curvata in Figure 373). In several species the PEP is wide and lamelliform, and seems to perform the function of protecting the embolus, except its distal portion, which is protected by the tegular membrane. In araneoids the ejaculatory duct does not go through the conductor, although the latter does protect the embolus (particularly its distal portion). Although the principle of minimizing the number of ad hoc hypotheses needed to establish a homology can be used in conjunction with the classical criteria, it might not be decisive. Resolving homologies might require weighting evolutionary steps when assessing alternative hypotheses. Then simplest explanations should be preferred to more complex ones, when there is a lack of strong evidence for the latter.

The primitive pimoid conductor is a relatively small membrane. An elongated and pointed projection of the conductor is synapomorphic for the hespera clade. A relatively large and bilobate conductor is synapomorphic for the brevita clade.

The PCS morphology is quite variable. The presumed primitive PCS conformation with a sclerotized connection to the paracymbium is exclusively found in the taxa of the three most basal branches of the preferred cladogram. The rest of pimoids share the apomorphic PCS membranous attachment.

In summary, the pimoids are a well-defined monophyletic group supported by several synapomorphies. Their long history as an enigmatic group of difficult taxonomic placement is partly a reflection of systematic methods in which explicit statement of the hypothesis of relationships was not always pursued. Even worse, the distinction between primitive and derived character states was not reflected in the taxonomic groups proposed, resulting in a poor fit between phylogeny and taxonomy. The sister group relationship of pimoids and linyphiids is confirmed with the addition of a new synapomorphy provided from the spinneret spigot morphology. The study of web architecture and its behavioral characters is likely to provide further support for the Pimoidae-Linyphiidae monophyly.

**Taxonomic Considerations**

The phylogenetic hypothesis that I propose (Figure 442) renders the genus *Louisfagea* polyphyletic. It is obvious that *crispa* has to be transferred into another genus, but then *Louisfagea* (breuili and rupicola) becomes a paraphyletic genus. Forcing the monophyly of *rupicola* and *breuili* requires an additional step, that is, 119 steps for the cladogram in Figure 442. A monotypic genus could be created for the type species (breuili), but then a new monotypic genus would have to be erected for *rupicola*. Monotypic supraspecific taxa for a single species are paraphyletic and therefore their creation should be avoided, except in the cases in which a species would be otherwise assigned to no genus (Platnick, 1976, 1977; Farris, 1976; see later). Obviously *rupicola* and *breuili* were united within the same genus on the basis of plesiomorphic characters.

The simplest solution, although not the only valid one, is to group all the pimoids under a single genus and to establish *Louisfagea* as a junior synonym of *Pimoa*. This latter alternative is the one that I have preferred (Hormiga, 1993). *Pimoa* (Chamberlin and Ivie, 1943) is the oldest available name. *Louisfagea* was made available by Brignoli (1971) as a replacement name for *Metella* Fage, 1931, because the latter was pre-occupied.

I shall provide here some comments regarding the affinities between the fossil genus *Acrometa* and *Pimoa*. There are some conspicuous differences in the male palp morphology between *Pimoa* and *Acrometa*. The cymbial denticulate process of pimoids is absent in *Acrometa*. The latter genus has a large paracymbium with small denticles, which, judging from Petrunkevitch (1942) and Wunderlich's (1979, 1986) illustrations, are different from those found in pimoids. Wunderlich (1979, fig. 1) first homologized the cymbial fold of *Acrometa* with the paracymbium, but subsequently (Wunderlich, 1986, figs. 273-275) the basal projection of the cymbium was
homologized with the paracymbium, as Petrunkevitch (1942) had originally done. *Acrometa* lacks the median apophysis and the pimoid cymbial sclerite. *Acrometa* has a chitinous spiral distally positioned on the tegulum, which has been homologized to the conductor by Wunderlich (1986) and to the embolus by Brignoli (1979). It also has a proximal chitinous spiral on the tegulum, which has been homologized to the embolus by Wunderlich (1986) and to the conductor by Brignoli (1979). Both structures are quite different from the pimoid conductor, which is reduced to a small membrane or absent in a few species. The proximal spiral could be homologized with the pimoid embolic process, but the position on the tegulum of the distal spiral suggests homology to the conductor, which renders the proximal spiral as the embolus.

*Acrometa* lacks the four synapomorphies provided by the male palpal morphology that support the monophyly of *Pimoa* (the female characters cannot be assessed due to the absence of female specimens of *Acrometa*). I do not know of any synapomorphy(ies) suggesting a sister group relationship between *Acrometa* and *Pimoa*. Therefore, it seems that the synonymy proposed by Wunderlich is unjustified. Brignoli (1979:36) rejected Wunderlich’s mentioned synonymy, but also pointed out the “non corrispondenza tra *Louisfagea* e *Pimoa*,” his conclusion being based mostly on male genitalic differences. However, the characters he suggested for *Louisfagea* are plesiomorphies (e.g., bifurcated pimoid embolic process, numerous denticles on the cymbial process, shorter epigynum, etc.) and cannot be used to support the monophyly of *Louisfagea*. The present study provides several characters that support the monophyly of all the species described within *Louisfagea* and *Pimoa*.

A different question is whether to rank the pimoids as a linyphiid subfamily or as a family of its own. I have ranked pimoids as a family (Hormiga, 1993), but because of the existence of only one pimoid genus, the inclusion of *Pimoa* in a family for itself falls under “ Gregg’s Paradox” (the family does not provide any new grouping information). It could be argued that sister taxa should have the same absolute rank, but Farris (1976) has shown that it is not a requirement of a phylogenetic classification: “phylogenetic classification requires only that each monophyletic group be a taxon, each taxon be a monophyletic group, and the natural inclusion relations of monophyletic groups be retained by the taxon.” But, what is to be gained from the removal of the pimoids from the Linyphiidae? Once it is clear that a sister group relationship exists between these two groups, the answer to that question is somewhat arbitrary. Linyphiids are a highly diverse group of poorly understood phylogenetic structure. The exclusion of the pimoids renders the Linyphiidae more homogeneous and therefore easier to diagnose. Some of the classical diagnostic characters of the linyphiids (e.g., the paracymbium and the embolic division, the loss of the araneoid conductor and median apophysis) would be “moved up one node” in a phylogenetic classification if we were to accommodate the pimoids within Linyphiidae. The price to pay for having the pimoids ranked as a family is to have an empty, and therefore meaningless, category in the classification, because the genus and the family would convey the same grouping information. Another alternative, as Farris (1976) has suggested, is to assign the genus to no family, because that is not a requirement of the rules of nomenclature. This alternative has the advantage of avoiding the pitfall of Gregg’s Paradox, retaining the diagnosis of Linyphiidae. The disadvantages are several. For the user of a classification it is easier to visualize the Araneoidea (or any other Superfamily) as a group of families, rather than families and genera. This point applies as well to catalogs and bibliographies. The lack of a familial assignment in the title of a publication might be misleading for the reader (e.g., it might implicitly suggest an incertae sedis relationship, because the genus is not placed in any family). These considerations have led me to the familial rank assignment for pimoids, in spite of the mentioned disadvantages.

### Biogeography

Pimoids live in the Himalayas, the Alps and the Cantabrian Mountains (northern Spain), and western North America. Their disjunct pattern suggests an ancestral, widespread, Holarctic distribution, with subsequent extinction in the intervening areas, as has already been suggested by Thaler (1976). The Himalayas and the Alps are relatively new formations, dating from the Tertiary, and have been suggested as refugia during the Pleistocene climatic changes. The opilionid genus *Sabacon* (Sabaconiidae) has a distribution almost identical to that of *Pimoa* (Thaler, 1976; Martens, 1983), although *Sabacon* also lives in eastern North America. Area cladograms from different taxa are required to study the historical relationships of these areas of endemism. Although such data are not available for organisms with distributions similar to those of *Pimoa*, we can produce area cladograms for the pimoids and examine what set of historical relationships of areas they suggest. A preliminary inspection of the distribution pattern of pimoids suggests three disjunct areas: western Europe, the Himalayas, and western North America. However, examination of the preferred cladogram for the Pimoidae (Figure 442), in conjunction with the distribution of the species, shows that Asia is the only area defined by a monophyletic group (the *gandhii* clade). No monophyletic group defines neither western North America nor western Europe. The occurrence of the *hespera* clade defines the most eastern area of the distribution of pimoids in North America, but the sister group to the *hespera* clade contains both North American and Asian taxa. The exclusion of the *gandhii* clade renders all the North American taxa as monophyletic, which may suggest a dispersal event (from North America to Asia) of a common ancestor of the *gandhii* clade, which has its closest relatives in western North America (the *alioculata* and *breviate* clades). The Pacific coast area between Coos county in Oregon and Sonoma county in northern California is the richest
area in North America in *Pimoa* species, though undefined as an area by any clade. The species occurring in the mentioned area are (from north to south): *altioculata*, *vera*, *breviata*, *mephitis*, *edenticulata*, and *cthulhu*). Western Europe is not defined by any clade either, because *rupicola* and *breviili* are two successive branches at the base of the pimoid cladogram (Figure 442). The two equally parsimonious alternative topologies (rooting options 1 and 2 in Figure 441C) have Europe and Asia as areas supported by monophyletic groups, but North America remains unsupported as an area.

The Himalayas are particularly rich in species for many groups of organisms (Martens, 1981). So far six species of pimoids are known from the Himalayas, but the group is probably at least as diverse there as it is in North America. *Pimoa* has been recorded from agricultural fields in eastern North America (Kentucky; Culin and Yeargan, 1983:42) but the record cannot be verified because the specimens are lost (K. Yeagar and J. Culin, pers. comm.). Until new specimens are recorded its presence in eastern North America should be regarded as dubious.

**Taxonomic Revision**

**PIMOIDEA Wunderlich**

**PIMOIDEA** Wunderlich, 1986:119.

**PIMOIDEA**.—Hormiga, 1993 [type genus by monotypy *Pimoa* Chamberlin and Ivie].

**DIAGNOSIS.**—Pimoidea contains only the genus *Pimoa* and therefore its diagnosis is the same as the genus.

**Pimoa Chamberlin and Ivie**


**DIAGNOSIS.**—Male palpus with a retrolateral cymbial sclerite and a dorsoectal cymbial process with denticles or cuspules (Figure 11, 68). Males differ from linyphiid males in having the paracymbium continuous with the base of the cymbium (the paracymbium is intersegmental in most linyphiids) and lacking an embolic division. Pimoids, in general, are larger in size than linyphiids. The epigynum is protruding, with a dorsal to lateral fold or groove with the copulatory opening at the distal end (Figures 14, 414). Pimoids usually have stridulatory striae on the ectal side of the chelicera. The somatic morphology is similar to that of *Meta* (Tetragnathidae), but in *Pimoa* the clypeus is higher, autosapys occurs at the patella-tibia junction, and they build sheet-webs (metines build orb webs).

**DESCRIPTION.**—Small- to medium-sized spiders, total length 5 to 12 mm. Cephalothorax longer than wide, ranging in length from 2.1 to 6.1 mm. Thoracic fovea elongated, wide, and conspicuous (Figure 413). All eyes of roughly the same diameter. ALE and PLE juxtaposed. Lateral eyes with canoe tapetum (Wunderlich, 1986:119, citing Homann in litt.). Eyes usually surrounded with dark pigment. Clypeus 1.43-3.00 times AME diameter (except in *crispa*, which has eyes of reduced size and the clypeus height is 4.20). Chelicerae large, with three prolateral and one to four retrolateral teeth. Stridulatory striae usually present on the ectal side of the chelicerae (Chamberlin and Ivie, 1943:9 erroneously described *Pimoa* as lacking stridulatory striae). Labium free and wider than long. Sternum (Figure 50) longer than wide, projecting behind coxae IV and usually dark. Legs longer and slender in the male, yellowish to dark brown and frequently with dark annuli (Figures 1 and 2). Femur I length 1.39 (female *curvata*)-3.31 (male *crispa*) times the cephalothorax length. Leg formula 1243 (except in *rupicola*, *laura*, and *ediculata*, *qq. v.*). All tarsi with three claws (Figures 178, 179). Femur IV with two dorsal spines. Spination patterns variable (inter- and intraspecifically). In most species all legs (but particularly I and II) densely covered with long setae, curved at the distal end, variable intraspecifically. Leg autosapys at the patella-tibia junction. Female pedipalp with claw (Figure 177). Metatarsus I trichobothrial in medial or proximal third (except in *cthulhu*), which has several trichobothria). Abdomen longer than wide, dark gray with light marks, sometimes chevron-like (Figures 24, 99, 134, and 230). Venter usually with two light longitudinal bands. Tracheal system haplotracheate (sensu Millidge, 1984). Colulus relatively large and fleshy, with setae (Figures 112, 332). Spinnerets with reduction of the aciniform fields to one or none spigots in the PMS and/or PLS (Figures 78-81, 143-146). PLS with peripheral cylindrical gland spigot that has an enlarged base (Figures 146, 336). Male pedipalpal tibia with a rounded dorsal protruberance, with 2-4 prolateral and 2-5 retrolateral trichobothria. Cymbium with alveolus in an eccentric position, close to the proteral margin (Figures 46, 303). Paracymbium continuous with the retrolateral cymbial margin. Cymbium wide, with a relatively large retrolateral cymbial sclerite, termed here pimoid cymbial sclerite (PCS). Dorsum of cymbium with a projection bearing dark denticles or cuspules (except in *ediculata*). Tegulum large, more or less globular and bearing a membranous conductor and a hook-shaped apophysis (median apophysis; it is absent in several species). Embolus long and filiform, curved following the margin of the tegulum. Embolus paralleled by a long process (pimoid embolic process, PEP) with which the embolus shares a common base. Epigynum with a dorsal and ventral plate that have at their margin a groove, the epigynal fold. Epigynal fold distally bears the copulatory opening (Figures 14, 140, 141). Copulatory ducts varying in length and degree of sinuosity. Spermathecae usually spherical, with short and lightly sclerotized fertilization ducts (Figures 12-14, 378-380).
NATURAL HISTORY.—Pimoids are relatively common spiders in western North America, particularly in the redwood forests. Little data are available about their abundance and occurrence in Eurasia. Because several isolated specimens found in collections were collected by generalist collectors in Asia, I presume that the spiders are at least as common and speciose in that part of the world as their relatives in North America. Pimoa breuili is common in caves (Ribera, pers. comm.). Fage (1946:387) mentions that *P. crispa* is abundant in the caves of the Dehra Dun district of India, where it can be found on the wet walls: “sur les parois humides, à la manière des Meta.” *Pimoa sinuosa* was fairly common in the area of Nepal where the only available specimens were collected (Coddington, pers. comm.). Pimoids seem to be restricted to humid areas, although I have collected specimens of *Pimoa brevata* and *P. edenticulata* under fairly dry conditions. Several species have been collected in caves (*rupicola, breuili, hespera, mephitis, mono*, and *crispa*) but their presence should probably be considered opportunistic (probably because of the higher humidity), although the two last mentioned species are known only from specimens collected in caves. Only in *crispa* is there a reduction of the eye diameter; the other species do not seem to present particular adaptations to the cavernicolous life.

North American pimoids build relatively large sheet webs,
usually close to the ground (Figures 3-8). The web is secured to nearby structures mainly on the sides, but some "dorsal" and "ventral" threads provide additional support. Among the commonest places for webs are fallen tree trunks and hollow stumps; they are also commonly found in road cuts, especially when the cuts are concave and provide a shadowy habitat (Figures 7, 8). Their webs also can be found on rural houses and other human-built structures. The spider moves on the undersurface of the web, as linyphiids do. They are nocturnal and during the day hide in retreats (such as cracks and holes, underneath bark, leaves, mosses, debris, etc.), which they leave only when a prey falls in the web. The webs vary in size. The largest web I have recorded was from an immature specimen of *breviata* in a redwood forest in Humboldt County (California), measuring around one square meter (approximately 1.10 \times 1.00 m). Other individuals (adults and immatures as well) of the same species in a nearby locality (in a xerophytic forest) had webs of no more than 20 cm of diameter. Perhaps the
explanation for this intraspecific variation in web size could be found in the variation of environmental conditions, such as humidity. Most of the webs that I have been able to study were built relatively close to ground level; some webs of *breviata* were built at heights up to approximately 1.50 m, on tree trunks covered by ivy (Figures 3, 4). The web of the Nepalese species *Pimoa sinuosa* is very similar to that of its North American relatives, as judged by the photographs of the webs taken by J. Coddington.

I was able to examine an eggcase of *P. edenticulata*, which was suspended beneath the web and guarded by a female. It was spherical (about 12 mm in diameter) and covered with debris (mostly small fragments of bark). It contained 65 first instar spiders. The eggsac of *cithulhu* is very similar, although I do not have data on the number of eggs. One eggsac of *haden* was examined; it was covered with little debris (although that seems to be a preservation artifact) and contained 105 eggs. One eggsac of *curvata* was also examined. It was spherical (9 mm in
diameter), covered with debris, and contained 83 eggs.

COMPOSITION.—Twenty-one species. Relationships of the genus are illustrated on the cladograms in Figures 440-442. Probably many more Asian species exist. The group is likely to be as speciose in Asia as it is in North America.

DISTRIBUTION.—Pimoids have a Holarctic distribution: Northern Spain (Cantabrian Mountains), southeastern France and northwestern Italy (the Alps and the Apennines), northern India and Nepal (the Himalaya Mountains), and western North America from California through Alaska (roughly between the Coast Ranges and the Sierra Nevada and Bitterroot Range; Figures 117, 189, and 337).
FIGURES 9–14.—Diagrammatic male and female genitalic morphology of pimoids: 9, *Pimia altioculata*, male expanded palp (removed from cymbium); 10, *Pimia breuili*, male expanded palp (removed from cymbium); 11, generalized cymbium (dorsal); 12, generalized epigynum (cleared), ventral; 13, same, dorsal; 14, same, lateral.
Key to the Species of Pimoa

MALES

1. PEP bifurcated [Figure 11]; metatarsus I trichobothrium in medial third ....... 2
   PEP non bifurcated [Figure 9]; metatarsus I trichobothrium in distal third or numerous (7-11) trichobothria ............. 3
2. Cymbium with two dorsoectal denticulate processes [Figure 44]; Northern Spain
   Cymbium with one dorsoectal denticulate process [Figure 16]; Southeastern France, Northern Italy ................................................................. P. breuili
3. PCS attached to cymbium by means of a membrane; paracymbium and PCS not interconnected ......................................................... 4
   PCS continuous with the paracymbium [Figure 91]; cymbial denticulate process with denticles in a row on ectal margin [Figure 87]; a second cymbial projection with a group of long and thick spines [Figure 89]; MA absent; metatarsus I with a row of 7-11 trichobothria; Northwestern California (Sonoma and Mendocino Co.) .................... P. cthulhu, new species
4. PCS (as seen in a ventral view of the palp) with an "inverted T" conformation [Figures 130, 190]; pedipalpal tibia elongated, much longer than wide [Figure 131], and with 5 or 6 retrolateral, 3 prolateral trichobothria .... 5
   PCS conformation otherwise; pedipalpal tibia with 3 retrolateral and 2 prolateral trichobothria ................................................................. 7
5. Metatarsus I sinuous, widest at one third of its length [Figure 129]; cymbial denticulated process rounded [Figure 128]; distal end of PEP not rolled [Figure 126]; Eastern California (Fresno, Tulare, and Tuolumne Co.) .... P. hespera
   Metatarsus I not sinuous; pedipalpal tibia with conical dorsal apophysis [Figure 193]; cymbial denticulated process pointed [Figure 190]; distal end of PEP rolled [Figure 100] ......................................................... 6
6. Pedipalp femur stout, its distal end wider than the pedipalpal tibia and with a group of thick spines [Figure 102]; Washington, Idaho, Montana, and British Columbia
   Pedipalpal femur slim, narrower than the pedipalpal tibia at its widest point and without a cluster of thick spines [Figure 193]; Washington and Idaho .......... P. jellisoni
7. Paracymbium short and procurved [Figure 234], except in nematoide in which the paracymbium is a small bump [Figure 285]; PCS shaped as a reversed J; Asia
   Paracymbium more or less triangular, when not triangular it is longer than wide; PCS shaped otherwise; Western North America ........................................ 8
8. Embolus longer than PEP ................................................................. 9
   Embolus shorter than PEP ................................................................. 10
9. Cymbial denticulate process long, thin, and pointed with a sclerotized membranous-like tegument between the posterior margin of the paracymbium and the lateral margin of the cymbium [Figure 285]; femur I without a group of thick spines in the proximal third; Nepal; female unknown .......... P. nematoide, new species
   Cymbial denticulate process with distal end curved towards the PCS [Figure 256]; femur I with a group of thick spines in the proximal third [Figure 265]; Nepal ................................................................. P. sinuosa, new species
10. Cymbial denticulate process large, with numerous (>20) denticles [Figure 233]; pedipalpal tibia longer than wide; India .............................................. P. crispa
    Cymbial denticulate process with 3 or 4 denticles [Figure 218]; pedipalpal tibia about as long as wide; India .............................................. P. gandhi, new species
    Pedipalpal trochanter without apophysis ........................................ 13
12. Cymbial denticulate process with 2 or 3 denticles [Figure 338]; Oregon; female unknown .......................................................... *P. petita*, new species  
Cymbial denticulate process with numerous denticles [Figure 301]; from Northern California through Alaska ................................. *P. altioculata*

13. PEP of same length as embolus; PCS smaller than paracymbium [Figure 347]; Oregon, California .............................................. *P. brevialta*  
PEP longer than embolus; PCS larger than paracymbium .......................... 14

14. Distal end of the cymbial denticulate process rounded; cymbium with a large lateral projection, parallel to the cymbial denticulate process [Figures 368, 369]; Washington, Oregon ................................................. *P. curvata*  
Cymbial denticulate process pointed and heavily sclerotized .................. 15

15. Cymbial process with denticles and with its distal end elongated [Figure 391]; middle part of PCS smooth, without hook [Figure 392]; Northeastern California ................................. *P. laurae*, new species  
Cymbial process without denticles, instead with a stout and thick curved hook [Figure 411]; PCS with a curved hook in middle part [Figures 410, 411]; Northern California ............................................. *P. edenticulata*, new species

### FEMALES

1. Epigynum protruding less than its width [Figures 29, 56]; metatarsus I trichobothrium in medial third; Europe ............................................. 2  
Epigynum protruding more than its width; metatarsus I trichobothrium in distal third; North America, Asia ............................................. 3

2. Turn of the copulatory duct (in lateral view) closer to the copulatory opening than to the spermatheca [Figure 60]; Northern Spain ................................................. *P. breuili*  
Turn of the copulatory duct (in lateral view) closer to the spermatheca than to the copulatory opening [Figure 32]; France, Italy ................................................. *P. rupicola*

3. Epigynum very long and "sausage-like," the ventral plate having an elongated opening in the dorsal side of the epigynum [Figures 95, 119]; Western California .......................................................... 4  
Epigynum otherwise ........................................................................ 5

4. Distal end of epigynum pointing towards abdominal wall and latero-compressed [Figures 92, 93]; Northwestern California (Sonoma and Mendocino Co.) ........ *P. cthulhu*, new species  
Distal end of the epigynum rounded [Figure 120]; Western Oregon; male unknown .......................................................... *P. vera*

5. Distal end of epigynal margin rounded and without projections or "horns" .... 6  
Distal end of epigynal margin otherwise ............................................. 9

6. Epigynal ventral plate opening key-hole shaped [Figures 162, 196]; copulatory duct length larger than spermatheca width ............................................. 7  
Epigynal ventral plate opening otherwise; distal end of epigynum pointing towards posterior end of abdomen [Figures 138, 149]; copulatory duct length smaller than spermatheca width ............................................. 8

7. Epigynum protruding more or less perpendicularly to abdominal wall [Figure 163]; Washington, Idaho, Montana, and British Columbia ................. *P. haden*  
Epigynum protruding more or less parallel to abdominal wall [Figures 197, 200]; Washington and Idaho ................................................. *P. jellisoni*

8. Distance between the distal ends of copulatory ducts equal or larger than one spermatheca width [Figure 141]; Eastern California (Fresno, Tulare, and Tuolumne Co.) ................................................. *P. hesperal*  
Distance between the distal ends of copulatory ducts less than one spermatheca width [Figure 152]; Eastern California (Mono Co.); male unknown ................................................. *P. mono*, new species
9. Epigynal fold lateral [Figures 230, 250]; Asia ......................... 10
   Epigynal fold dorsal [Figures 313, 378]; North America ............ 14
10. Copulatory ducts (left and right) fused near spermatheca [Figures 229, 251]. 11
   Copulatory ducts not fused ........................................ 12
11. Dorsal and ventral epigynal lips of approximately same width [Figure 225]; India .
    Dorsal epigynal lip thin, narrower than ventral lip [Figure 250]; India; male unknown Unless stated otherwise, use new species
   P. gandhii, new species
12. Copulatory duct with double switch [Figures 272, 298] ................ 13
   Copulatory duct without double switch [Figure 247]; India ...... P. crispa
13. Two epigynal lips clearly marked [Figure 292]; in lateral view, epigynum distal end
    narrower than 1/2 width of base; Western China; male unknown
    P. anatolica, new species
14. Epigynum distal end pointed and sclerotized [Figure 431]; Northern California;
    male unknown .................................................. P. mephitis, new species
   Epigynum otherwise ........................................... 15
15. Epigynum distal end projecting (scape-like) and heavily sclerotized; [Figure 312];
    from Northern California through Alaska ......................... P. alliicolata
   Epigynum with dorsal plate projections [Figures 349, 397] ........ 16
16. Epigynum with dorsal plate projection rounded and thick [Figures 376, 378];
    Washington, Oregon ............................................. P. curvata
   Dorsal plate projections not rounded, more or less pointed ....... 17
17. Dorsal plate projections very short and sclerotized [Figure 349]; Oregon, California
    P. brevita
   Dorsal plate projections otherwise ................................ 18
18. Dorsal plate projection curved ventrally [Figure 397]; Northeastern California .
    P. laurae, new species
   Dorsal plate projection straight [Figure 415]; Northern California .. P. edenticulata, new species

Pimoa rupicola (Simon)
FIGURES 15-42
Labulla (Metella) rupicola.—Fage, 1935:177-180, fig. 2 [♂♀].
Metella rupicola.—Fage, 1946:387.
Pimoa rupicola.—Hormiga, 1993:534.

Typs.—I have not been able to locate the holotype of this species.

Diagnosis.—Males can be distinguished from breuili by having only one cymbial denticulate process (Figure 16).
   Females can be distinguished from breuili by having (in lateral view) the turn of the copulatory duct closer to the spermatheca than to the copulatory opening (Figure 32).

Male (from Alpi Apuane): Total length 5.2. Cephalothorax 2.7 long, 2.1 wide, 1.6 high; light brown. Sternum 1.7 long, 1.4
   wide; dark brown. Abdomen 3.1 long, 1.7 wide; whitish with gray pattern, some guanine spots on dorsum (Figure 20). AME diameter 0.14. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.57 times their diameter, PME separation 0.71 times their diameter. PME-PLE separation 0.86 times one PME diameter, AME-ALE separation 0.57 times one ALE diameter. Clypeus height 2.14 times one AME diameter.
   Chelicerae with three prolateral and two retrilateral teeth. Cheliceral stridulating files present and conspicuous. Legs light brown. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>6.7</td>
<td>5.3</td>
<td>4.2</td>
<td>5.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.0</td>
<td>0.9</td>
<td>0.7</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td>Tibia</td>
<td>–</td>
<td>–</td>
<td>3.7</td>
<td>5.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>–</td>
<td>–</td>
<td>4.0</td>
<td>5.0</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>–</td>
<td>–</td>
<td>1.5</td>
<td>2.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>–</td>
<td>14.1</td>
<td>19.0</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Femur I 2.48 times length of cephalothorax. Metatarsus I trichobothrium (measured in another specimen) 0.59. Pedipalp
as in Figures 15-19, 36.
FIGURES 15–22.—*Pimcia rupicola* (Simon), male from France: 15, palp, ventral; 16, same, ectal; 17, same, detail cymbium, dorsoectal; 18, same, mesal; 19, same, dorsal; 20, abdomen, dorsal; 21, cephalothorax, lateral; 22, same, frontal. (Scale lines: 0.5 mm, except 20–22, 1.0 mm.)
FIGURES 23–35.—*Pmoa rupecola* (Simon), female: 23, female from Italy, habitus, lateral; 24, female from Italy, abdomen, dorsal; 25, same, lateral; 26, female from Italy, abdomen, dorsal; 27, female from France, epigynum, ventral; 28, same, posterior; 29, same, lateral; 30, same epigynum, cleared, dorsal; 31, same, posterior; 32, same, lateral; 33, 34, same, ventral; 35, same, anterior. (Scale lines: 1.0 mm, except 27–35, 0.5 mm.)
Female (from same locality as male): Total length 7.0. Cephalothorax 2.2 long, 2.4 wide, 2.0 high; light brown, darker at margins. Sternum 1.6 long, 1.5 wide; dark brown. Abdomen 3.9 long, 2.6 wide, 2.6 high; whitish with light gray pattern, some guanine spots on dorsum (Figures 23–26). AME diameter 0.16. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.63 times their diameter, PME separation 0.63 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 0.75 times one ALE diameter. Clypeus height 2.63 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present but inconspicuous and scale-like. Legs light brown, with very light gray annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>5.3</td>
<td>4.6</td>
<td>3.5</td>
<td>4.9</td>
<td>1.1</td>
</tr>
<tr>
<td>Patella</td>
<td>1.2</td>
<td>1.0</td>
<td>0.8</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>5.5</td>
<td>4.6</td>
<td>3.2</td>
<td>4.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>5.2</td>
<td>4.4</td>
<td>3.4</td>
<td>4.7</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.2</td>
<td>2.0</td>
<td>1.5</td>
<td>2.1</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>19.4</td>
<td>16.6</td>
<td>12.4</td>
<td>17.4</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Legs 1423. Femur I 2.41 times length of cephalothorax. Metatarsus I trichobothrium 0.61. Epigynum as in Figures 27–35, 37.

Variation.—Male cephalothorax ranges in length from 2.1 to 2.7, female from 2.2 to 4.5. Overall degree of pigmentation and density and length of the setae covering the legs varies, some individuals lacking long setae on the legs and others being densely covered by long setae. The number of retrolateral cheliceral teeth in the females varies from one to two.

Additional Material Examined.—France: Alpes Maritimes (MNHN), 1♂, 3♀; Alpes Maritimes, Cagnes (Berland, MNHN), 3♀; Menton, 22 Mar 1915 (MNHN), 1♂, 8♀; Italy: Alpi Apuane, 16 Oct 1975, 500 m, (IZUI), 1♂, 1♀; Alpi Cozie, Giaveno forno n. Torino, Oct 1972, 50 m (JW), 1♀; Alpi Cozie, Saluzzo, Bagnolo Piemonte, 8 Oct 1972, 1050 m (IZUI), 1♀; Appennino Ligure, Ponto di Nava, Grotta dell Ono (PO99%/118Pi), 6 Aug 1971 (M. Bologna, JW), 1♀; Appennino Ligure, M. Alta Val Nervia, Margheria dei Boschi, Tana Rossa, 7 Sep 1971, 1100 m (S. Bologna, JW), 1♂; Alpi Maritime, Ligure, Ormea, Isola Pera, 2 Oct 1972, 600 m (IZUI), 1♀; Appennino Ligure, Savona prov., C. Giovetti, Massimino, 2 Oct 1972, 900 m (IZUI), 1♀; Appennino Tosco-Emiliano, Toscana, Passo del Cerreto, 20 Oct 1975, 1120 m (IZUI), 1♀.

Distribution.—Known from mountainous regions in meridional France (Alpes Maritimes and Var) and Italy (Piemonte, Toscana, and Liguria) (Figure 42).
FIGURES 38–41.—*Pitho* rupicola (Simon), spinnerets, female: 38, spinneret group; 39, ALS; 40, PMS; 41, PLS.
Pimoa breuili (Fage)

FIGURES 10, 42-84


*Labulla (Metella) breuili.*—Fage, 1935:177-180, fig. 1 [♂].—Dresco and Hubert, 1971:200-201.

*Labulla breuili.*—Bonnet, 1957:2828.


*Acrometa breuili.*—Wunderlich, 1979:411-416, figs. 2-11 [♂].

*Pimoa breuili.*—Hormiga, 1993:534.

**TYPES.**—Female holotype, labels state "*Metella breuili* Fage" and "*Fage, Type! biosp. n° 792. Caverna de San Román de Candamo, part. de Pravia, prov. Oviedo, Espagne." Deposited in MNHN. Examined.

**DIAGNOSIS.**—Both sexes have legs covered with numerous long setae. Male with bifurcated PEP and two denticulated cymbial processes. Epigynum protruding less than its width; the turn of the copulatory duct (in a lateral view of the epigynum) is closer to the copulatory opening than to the spermatheca (Figure 45).

**Male** (from Reverga, Asturias, Spain): Total length 7.1. Cephalothorax 3.5 long, 2.7 wide, 2.0 high; yellowish brown. Sternum 2.1 long, 1.7 wide; brown, darker at margins. Abdomen 4.0 long, 2.1 wide, 2.8 high; whitish with dark gray pattern. AME diameter 0.22. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.29 times their diameter, PME separation 1.00 times their diameter. PME-PLE separation 0.71 times one PME diameter, AME-ALE separation 0.71 times one ALE diameter. Clypeus height 2.00 times one AME diameter. Chelicerae with three prolateral and two (three) retrolateral teeth. Cheliceral stridulating files present (Figure 73). Legs reddish brown. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>11.2</td>
<td>10.0</td>
<td>6.9</td>
<td>8.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Patella</td>
<td>1.4</td>
<td>1.3</td>
<td>1.1</td>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>12.0</td>
<td>10.5</td>
<td>6.4</td>
<td>9.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>13.7</td>
<td>12.2</td>
<td>7.3</td>
<td>9.8</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.3</td>
<td>2.9</td>
<td>2.1</td>
<td>2.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Total</td>
<td>41.6</td>
<td>36.9</td>
<td>23.8</td>
<td>31.8</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Legs 1243. Femur 13.20 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.58. Pedipalp as in Figures 43-48, 53, 54, 64-70.

**Female** (from same locality as male): Total length 8.5. Cephalothorax 4.5 long, 3.0 wide, 2.1 high; reddish brown.
FIGURES 43-52.—*Pimela brevii* (Lage), male from Asturias, Spain: 43, palp, ventral; 44, same, ectal; 45, same, dorsoectal; 46, cymbium (basal haematodocha removed), ventral; 47, detail PEP branches; 48, palp, mesal; 49, cephalothorax, dorsal; 50, same, ventral; 51, same, frontal; 52, abdomen, dorsal. (Scale lines: 0.5 mm, except 47, 0.25 mm and 49-52, 1.0 mm.)
FIGURES 53, 54.—*Pinoa breuili* (Fage), male from Asturias, Spain, expanded palp: 53, dorsal; 54, antero ectal.
(Scale line: 1.0 mm.)

Sternum 2.5 long, 1.8 wide; dark reddish brown. Abdomen 5.1 long, 3.4 wide, 3.6 high; whitish with dark gray pattern. AME diameter 0.22. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.29 times their diameter, PME separation 1.00 times their diameter. PME-PLE separation 1.00 times one PME diameter. AME-ALE separation 1.00 times one ALE diameter. Clypeus height 2.57 times one AME diameter. Chelicerae with three prolateral and two (three) retrolateral teeth. Cheliceral stridulating files present although quite inconspicuous. Legs reddish brown. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>9.4</td>
<td>8.5</td>
<td>6.4</td>
<td>8.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Patella</td>
<td>1.7</td>
<td>1.6</td>
<td>1.3</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>9.7</td>
<td>8.4</td>
<td>5.6</td>
<td>8.9</td>
<td>1.1</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>9.8</td>
<td>8.9</td>
<td>5.7</td>
<td>7.9</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.2</td>
<td>2.9</td>
<td>2.0</td>
<td>2.5</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>42.8</td>
<td>30.3</td>
<td>21.0</td>
<td>28.8</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.09 times length of cephalothorax. Metatarsus I trichobothrium 0.62. Legs covered with long setae. Epigynum as in Figures 55–60.

**VARIATION.**—Male cephalothorax ranges in length from 3.5 to 5.7, female from 2.8 to 4.9. The general coloration varies, some individuals being fairly light in color while others are heavily pigmented.

**ADDITIONAL MATERIAL EXAMINED.**—SPAIN: ASTURIAS: Babia de Abajo, 5 Sep 1987 (Ribera, Serra, Domínguez, UB), 1♂, 2♀; Oviedo, Cueva del Agua, Boquerón de Brañes, 3 Sep 1987 (Ribera, Serra, Domínguez, UB), 2♂, 1♀; Cueva del Escribano, La Escalda, 3 Sep 1987 (Ribera, Serra, Domínguez, UB), 2♂, 1♀; Cueva de la Huerta, Tevega (C. Bolivar, MNHN), 1♂; Cueva de la Huerta, Tevega, 1 Sep 1987 (Ribera, Serra, Domínguez, UB), 2♂, 6♀.

**DISTRIBUTION.**—Known only from the Cordillera Cantábrica, in northern Spain. Its distribution in the caves of northern Spain is given by Ribera (1980:228–229). Ribera’s locality records (when adult specimens were collected) have been included in the distribution map (Figure 42).
FIGURES 55–63.—Pimoa breuili (Fage), female from Asturias, Spain: 55, epigynum, posteroverentral; 56, same, lateral; 57, epigynum, cleared, posterior; 58, same, anteroventral; 59, same, anterior; 60, same, lateral; 61, abdomen, dorsal; 62, cephalothorax, dorsal; 63, same, frontal. (Scale lines: 0.5 mm, except 61–63, 1.0 mm.)
FIGURES 64-70. — *Pimoa breuili* (Fage), male from Asturias, Spain: 64, palp, ventral; 65, paracymbium and PCS, ectal; 66, embolus, conductor, and median apophysis; 67, embolus (apex) and conductor; 68, cymbial denticulated process; 69, 70, cymbial denticles, detail.
FIGURES 71–77.—*Pimlea breuili* (Fage), male from Asturias, Spain: 71, tarsal claw I; 72, stridulatory striae, detail of 74; 73, base of palp femur, mesal with enlarged setal bases; 74, chelicera with stridulatory striae; 75, detail of striae; 76, metatarsus I; 77, tarsal organ I.
FIGURES 78–81.—*Pimela brevica* (Fage), spinnerets, female from Asturias, Spain: 78, spinneret group; 79, ALS; 80, PMS; 81, PLS.
FIGURES 82–84.—*Pimoa breuili* (Fage), spinnerets, female from Asturias, Spain: 82, PMS; 83, 84, PLS, detail.

**Pimoa cthulhu**, new species


**ETYMOLOGY.**—Named after H.P. Lovercraft’s mythological deity Cthulhu, akin to the powers of Chaos.

**DIAGNOSIS.**—Males can be easily distinguished by a cluster of thick spines on a cymbial projection (Figures 85, 89, 107). The paracymbium is long and continuous with the PCS. Females have a long sausage-like epigynum that can be distinguished from its sister species *vera* because of *cthulhu’s* narrower and laterally compressed distal end (Figures 92–97).

**Male** (holotype): Total length 10.5. Cephalothorax 4.8 long, 3.8 wide, 2.6 high; very light brown, slightly darker at margins. Sternum 2.8 long, 2.2 wide; brown. Abdomen 5.1 long, 3.8 wide, 5.0 high; dark gray with four dorsal whitish spots, very similar to the female. AME diameter 0.28. PME 0.79, PLE 0.79, ALE 0.79 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.91 times their diameter. PME-PLE separation 1.18 times one PME diameter. AME-ALE separation 0.73 times one ALE diameter. Clypeus height 1.43 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files scale-like and inconspicuous. Legs brown. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>12.8</td>
<td>11.6</td>
<td>8.6</td>
<td>10.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.8</td>
<td>1.8</td>
<td>1.5</td>
<td>1.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Tibia</td>
<td>12.4</td>
<td>11.4</td>
<td>7.4</td>
<td>9.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>14.6</td>
<td>13.7</td>
<td>8.7</td>
<td>11.1</td>
<td>-</td>
</tr>
<tr>
<td>Tarsus</td>
<td>4.8</td>
<td>4.2</td>
<td>3.3</td>
<td>3.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
<td>46.3</td>
<td>42.7</td>
<td>29.5</td>
<td>36.0</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Legs 1243. Femur 12.67 times length of cephalothorax. Legs covered with long setae (Figure 98). Metatarsus I with eleven trichobothria. Pedipalp as in Figures 85–91, 101–107, 110, 111.

**Female** (paratype): Total length 12.3. Cephalothorax 5.6 long, 4.1 wide, 6.4 high; light brown, darker at the margins. Sternum 2.8 long, 2.3 wide; reddish brown. Abdomen 6.8 long, 5.4 wide, 7.2 high; dark gray with four dorsal whitish spots. AME diameter 0.30. PME 0.80, PLE 0.73, ALE 0.73 times one AME diameter. AME separation 0.47 times their diameter, PME separation 0.83 times their diameter. PME-PLE separation 1.36 times one PME diameter. AME-ALE separation 1.00 times one ALE diameter. Clypeus height 1.73 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files scale-like. Legs dark reddish...
FIGURES 85-91.—*Pimoa cthulhu*, new species, males from California: 85, palp, ventral; 86, same, mesal; 87, same, ectal; 88, same, detail base of cymbium, ectoventral; 89, same, dorsal; 90, palp, dorsal; 91, same, ventral (basal haematodocha removed). (Scale lines: 0.5 mm.)
FIGURES 92–100.—*Pimoo cthulhu*, new species, female: 92, epigynum, ventral; 93, same, lateral; 94, epigynum, cleared, ventral; 95, same, dorsal; 96, same, anterior; 97, same, lateral; 98, paratype, detail metatarsus I; 99, paratype, abdomen, dorsal; 100, same, lateral. (Scale lines: 0.5 mm, except 99, 100, 2.0 mm.)
brown. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>11.3</td>
<td>10.1</td>
<td>7.5</td>
<td>9.8</td>
<td>2.5</td>
</tr>
<tr>
<td>Patella</td>
<td>2.0</td>
<td>1.9</td>
<td>1.6</td>
<td>1.8</td>
<td>1.4</td>
</tr>
<tr>
<td>Tibia</td>
<td>11.2</td>
<td>9.9</td>
<td>6.5</td>
<td>9.1</td>
<td>0.7</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>12.0</td>
<td>10.6</td>
<td>7.3</td>
<td>9.2</td>
<td>0.7</td>
</tr>
<tr>
<td>Tarsus</td>
<td>4.2</td>
<td>3.6</td>
<td>2.4</td>
<td>3.0</td>
<td>2.1</td>
</tr>
<tr>
<td>Total</td>
<td>40.7</td>
<td>36.1</td>
<td>25.3</td>
<td>32.9</td>
<td>6.7</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.02 times length of cephalothorax. Legs covered with long setae (Figure 98). Metatarsus I with eight trichobothria. Epigynum as in Figures 92–97, 108, 109.

VARIATION.—Male cephalothorax ranges in length from 4.4 to 5.7, female from 4.0 to 6.1. The number of metatarsal trichobothria is quite variable in this species. In the males it varies from seven to 11 for the first and from seven to nine for the fourth metatarsus. In the females it varies from eight to 10 for the first and from six to 10 for the fourth metatarsus. The number of prolateral trichobothria of the male pedipalp tibia varies from three to four.
FIGURES 107-112.—Pimoa cthulhu, new species, from California: 107, cymbial apophysis; 108, epigynum, dorsoapical detail; 109, closeup of cuticular openings of Figure 108; 110, cymbial denticulated process, 111, cymbial denticle; 112, female, colulus and spiracle.

ADDITIONAL MATERIAL EXAMINED.—UNITED STATES: CALIFORNIA: Mendocino Co.: 1 mi (1.6 km) S of Caspar (39°N, 123°W), 13 Sep 1961 (W.J. Gertsch, W. Ivie, AMNH), 2q; 9.8 mi (15.7 km) SW Highway 101, along Highway 1, 20 Sep 1990, web in hollowed out redwood stump, 1000 ft (D. Ubick, DU), 1q; Mendocino Woodlands, 26 Mar 1977 (P.R. Craig, CAS), 1♂; 3.0 mi (4.8 km) S of Rockport, 19 Sep 1990, web in burned out cavity in redwood stump, 300 ft (D. Ubick, DU), 1q; Tranquility, 1.5 mi (2.4 km) S of Caspar, 19 Sep 1990, webs in shed, 300 ft (D. Ubick, J. Helfer, DU), 4♂, 1q; 1 mi (1.6 km) NE Usal Road, along Highway 101, 20 Sep 1990, in redwood duff, 200 ft (D. Ubick, DU), 1q; Sonoma Co.: Salt Point State Park, 22 Sep 1990, webs in hollow redwood stumps under logs (D. Ubick, V. Vutrain, S. Lee, DU), 2♂, 2q.

DISTRIBUTION.—Known only from Mendocino and Sonoma counties in Western California (Figure 117).
FIGURES 113–116.—Pimpa cthulhu, new species, spinnerets, female from California: 113, spinneret group; 114, ALS; 115, PMS; 116, PLS.
FIGURE 117.—Distributions of *Pimoa petita*, new species (open square), *P. vera* Gertsch (open upright triangle), *P. mephitis* new species (inverted open triangles), *P. edenticulata* new species (inverted closed triangles), *P. cthulhu*, new species (circles), *P. laurae* new species (closed upright triangles), *P. mono*, new species (diamond), and *P. hespera* (Gertsch and Ivie) (closed squares).

**Pimoa vera** Gertsch

*Pimoa vera* Gertsch, 1951:4-6, fig. 6 [♀].—Brignoli, 1975:13; 1983:231.—Roth, 1988:45.

**TYPES.**—Female holotype, label states “Pimoa vera Gertsch Oregon: North Bend Vera Norton coll. ♀ HOLOTYPE.” Deposited in AMNH. Examined.

**DIAGNOSIS.**—It can be distinguished from its sister species *cthulhu* by the rounded distal end of the epigynum (which is laterocompressed in *cthulhu*; Figures 118–123).

**Male:** Unknown.

**Female** (holotype): Cephalothorax 4.2 long, 3.3 wide, 2.3 high; reddish brown. Sternum 2.5 long, 1.9 wide; yellowish brown. Abdomen yellowish brown. AME diameter 0.22. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 1.40 times their diameter, PME separation 1.40 times their diameter. PME-PLE separation 1.14 times one PME diameter, AME-ALE separation 1.00 times one ALE diameter. Clypeus height 2.14 times one AME diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files absent. Legs yellowish brown. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>9.1</td>
<td>8.5</td>
<td>6.5</td>
<td>-</td>
<td>1.5</td>
</tr>
<tr>
<td>Patella</td>
<td>3.3</td>
<td>3.3</td>
<td>3.3</td>
<td>-</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.1</td>
</tr>
<tr>
<td>Tarsus</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.0</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Femur I 2.17 times length of cephalothorax. Epigynum as in Figures 118–123.

**ADDITIONAL MATERIAL EXAMINED.**—None.

**DISTRIBUTION.**—Known only from the type locality, in western Oregon (Figure 117).
Pimoa hespera (Gertsch and Ivie)

FIGURES 126–146, 117

Acrometa hespera.—Wunderlich, 1979:411.


DIAGNOSIS.—Males can be easily distinguished by having the metatarsus I sinuous and widest at the distal end of the proximal third (Figure 129). Females can be distinguished from its sister species mono by a less rounded end of the epigynum and the distance between the copulatory openings (approximately equal to one spermatheca width; Figures 140, 141).

Male (from Kings Canyon National Park, California): Total length 9.3. Cephalothorax 4.5 long, 3.4 wide, 2.6 high; light brown, slightly darker at margins. Sternum 2.6 long, 2.1 wide; dark brown. Abdomen 4.5 long, 3.3 wide, 3.9 high; whitish with a dark gray pattern. AME diameter 0.22. PME 0.91, PLE 0.91, ALE 0.91 times one AME diameter. AME separation 0.73 times their diameter, PME separation 0.80 times their diameter. PME-PLE separation 1.01 times one PME diameter. AME-ALE separation 0.80 times one ALE diameter. Clypeus height 2.36 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present and conspicuous. Legs brown, annuli very faintly marked. Leg and pedipalp lengths of male described above:
Figures 126-134.—*Pimca hespera* (Gertsch and Ivie), males from California: 126, holotype, palp, ventral; 127, same, apical; 128, same, dorsal; 129, tibia I, ectal; 130, palp, dorsal; 131, same, mesal; 132, cephalothorax, dorsal; 133, abdomen, lateral; 134, same, dorsal (Figures 126-128 right palp reversed). (Scale lines: 0.5 mm, except 132-134, 1.0 mm.)
FIGURES 135-142.—*Pinoa hespera* (Getzsch and Ivie), females from California: 135, epigynum, ventral; 136, same, posterior; 137, same, dorsal; 138, epigynum, lateral; 139, same, ventral; 140, epigynum, cleared, dorsal; 141, same, ventral; 142, abdomen, dorsal. (Scale lines: 0.5 mm. except 142, 1.0 mm.)

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>10.7</td>
<td>9.8</td>
<td>7.5</td>
<td>9.0</td>
<td>3.7</td>
</tr>
<tr>
<td>Patella</td>
<td>1.8</td>
<td>1.7</td>
<td>1.4</td>
<td>1.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Tibia</td>
<td>10.2</td>
<td>9.2</td>
<td>6.2</td>
<td>8.2</td>
<td>1.8</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>12.4</td>
<td>11.2</td>
<td>7.0</td>
<td>9.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Tarsus</td>
<td>4.5</td>
<td>3.7</td>
<td>2.2</td>
<td>2.9</td>
<td>8.0</td>
</tr>
<tr>
<td>Total</td>
<td>39.6</td>
<td>35.6</td>
<td>24.3</td>
<td>30.8</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.38 times length of cephalothorax. Metatarsus I sinuous and thickened near the proximal end (Figure 129). Legs (especially I and II) covered with long setae. Metatarsus I trichobothrium 0.85. Pedipalp as in Figures 126–128, 130, 131.

*Female* (from Deep Creek Cave, California): Total length 9.5. Cephalothorax 4.6 long, 3.4 wide, 2.15 high; yellowish brown, darker at margins and anterior to the thoracic fovea. Sternum 2.70 long, 1.95 wide; dark brown. Abdomen 6.0 long, 3.7 wide, 5.1 high; whitish with dark gray pattern. AME diameter 0.20. PME 0.90, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.60 times their diameter, PME separation 0.89 times their diameter. PME-PLE separation 1.33 times one PME diameter, AME-ALE separation 1.00 times one ALE diameter. Clypeus height 2.60 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present, but less conspicuous than in the male (and scale-like). Legs brown, darker than the cephalothorax, with annuli very faintly marked. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>8.7</td>
<td>7.8</td>
<td>6.1</td>
<td>7.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.6</td>
<td>1.5</td>
<td>1.3</td>
<td>1.4</td>
<td>0.7</td>
</tr>
<tr>
<td>Tibia</td>
<td>8.7</td>
<td>7.8</td>
<td>5.2</td>
<td>7.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>8.8</td>
<td>7.9</td>
<td>5.6</td>
<td>7.3</td>
<td>1.9</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.5</td>
<td>3.1</td>
<td>2.1</td>
<td>2.5</td>
<td>5.7</td>
</tr>
<tr>
<td>Total</td>
<td>31.29</td>
<td>28.08</td>
<td>20.28</td>
<td>25.86</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.89 times length of cephalothorax. Legs (especially I and II) covered with long setae. Metatarsus I
trichobothrium 0.85. Epigynum as in Figures 135–141.

VARIATION.—Male palp morphology exhibits some variation in the shape of the paracymbium (more pointed in the holotype than in other specimens examined) and the median apophysis (slightly thicker and more compressed in the specimen from Kings Canyon N. P.). Female cephalothorax ranges in length from 4.0 to 5.2. Some female specimens are very dark, with the light dorsal abdominal marks reduced.

Additional Material Examined.—UNITED STATES: California: Fresno Co.: Kings Canyon National Park, Cedar Grove, 8 Aug 1953, 5200 ft (W.J. and J.W. Gertsch, AMNH), 1♀; Tulare Co.: Ash Mtn., Sequoia Nat. Park (36°30'N, 118°50'W), 9 Jul 1958 (W.J. Gertsch, V. Roth, AMNH), 1♀; Deep Creek Cave, 30 Sep 1980 (W. Rauscher and T.S. Briggs, DU), 1♀; Hurricane Crawl Cave, 26 Jul 1991 (T. Briggs, DU), 1♀; Kings Canyon National Park: Redwood Canyon, Lilburn...
FIGURES 147-155.—*Pimoa mono*, new species, female from California: 147, epigynum, ventral; 148, same, dorsal; 149, same, lateral; 150, epigynum, lateral; 151, same, posterior; 152, epigynum, cleared, ventral; 153, same, dorsal; 154, abdomen, dorsal; 155, same, lateral. (Scale lines: 0.5 mm, except 154, 155, 1.0 mm.)

**Pimoa mono**, new species

**FIGURES** 147-155, 117

**TYPES.**—Female holotype and three females paratypes from Meander Cave, Twin Lakes, near Mono Hot Springs, Mono Co., California; 3 Sep 1972, A. Jung, B. Lem, and T. Briggs col. Holotype deposited in CAS, paratypes deposited in DU.

**ETYMOLOGY.**—The species epithet is a noun in apposition taken from the county name of the type locality.

**DIAGNOSIS.**—It can be distinguished from its sister species Cave, Mayr’s entrance, 17 Aug 1984, 1600 m (T.S. Briggs and D. Ubick, DU), 1♂, 1♀; Kings Canyon National Park: Redwood Canyon, Mayr’s Cave, Nov 1966, 1600 m (V.F. Lee, CAS), 3♀; 16 Aug 1984 (T.S. Briggs, V.F. Lee, and D. Ubick, DU), 1♀; Sequoia National Park, 1945 (F.R. Oberhansley, AMNH), 1♀; Soda Cr., W of Camp Nelson (118°45'N, 36°09'W), 11 Jul 1958 (V.D. Roth and W.J. Gertsch, AMNH), 1♀.

**DISTRIBUTION.**—Known from the Fresno, Tuolumne, and Tulare counties in eastern California (Figure 117).
**FIGURES 156-160.** — *Pimia haden* Chamberlin and Ivie, male from Washington: 156, palp, ventral; 157, same, apical; 158, same, dorsal; 159, holotype, palp, ventral; 160, abdomen, dorsal. (Scale lines: 0.5 mm, except 160, 1.0 mm.)

*hespera* by the rounded end of the epigynum and the small distance between the copulatory openings (Figures 152, 153).

**Male:** Unknown.

**Female** (holotype): Cephalothorax 5.0 long, 3.5 wide, 2.5 high; brown. Sternum 2.8 long, 2.1 wide; dark brown. Abdomen 6.0 long, 4.0 wide, 4.7 high; whitish with a dark gray pattern. AME diameter 0.20, PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.90 times their diameter, PME separation 0.90 times their diameter. PME-PLE separation 1.20 times one PME diameter, AME-ALE separation 0.90 times one ALE diameter. Clypeus height 3.00 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files scale-like and inconspicuous. Legs dark reddish brown. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>10.9</td>
<td>9.8</td>
<td>7.4</td>
<td>8.8</td>
<td>2.1</td>
</tr>
<tr>
<td>Patella</td>
<td>1.9</td>
<td>1.9</td>
<td>1.5</td>
<td>1.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Tibia</td>
<td>11.2</td>
<td>10.1</td>
<td>6.4</td>
<td>7.7</td>
<td>1.5</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>11.4</td>
<td>9.9</td>
<td>2.1</td>
<td>7.8</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>4.2</td>
<td>3.6</td>
<td>2.3</td>
<td>2.8</td>
<td>2.1</td>
</tr>
<tr>
<td>Total</td>
<td>39.6</td>
<td>32.3</td>
<td>19.7</td>
<td>28.7</td>
<td>6.3</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.18 times length of cephalothorax. Legs (particularly I and II) covered with long setae. Metatarsus I trichobothrium 0.88. Epigynum as in Figures 90, 147, 153.

**VARIATION.** — Female cephalothorax ranges in length from 4.2 to 5.0.
FIGURES 161–168.—Pimoa haden Chamberlin and Ivie, female: 161, paratype, epigynum, ventral; 162, same, dorsal; 163, same, lateral; 164, paratype, abdomen, dorsal; 165, female from Washington, abdomen, dorsal; 166, female from Washington, epigynum, cleared, lateral; 167, same, ventral; 168, same, dorsal; 169, cephalothorax, frontal. (Scale lines: 0.5 mm, except, 164, 165, 169, 1.0 mm.)

ADDITIONAL MATERIAL EXAMINED.—None.

DISTRIBUTION.—Known only from the type locality in eastern California (Figure 117).

Pimoa haden Chamberlin and Ivie

FIGURES 156–189


TYPES.—Male holotype and female paratype, labels state “Pimoa haden Chamberlin and Ivie ♂♀ Idaho: Hayden Lake 34.70.” Deposited in AMNH. Examined.

DIAGNOSIS.—Male with distal end of the PEP rolled (Figure 99) and five to six retrolateral trichobothria in the palpal tibia, which also has dorsal conical apophysis. Very similar to its sister species jellisoni, but can be distinguished from it because haden has thicker pedipalpal femur which bears a group of spines in its ectal side (Figure 159). Females of haden and jellisoni are difficult to tell apart when their respective males are not available. The epigynum of haden (Figures 161–163) is projected more perpendicularly to the abdominal wall than in jellisoni, which has it more parallel to the abdomen.
Male (from Cedar Lake, Washington): Total length 7.9. Cephalothorax 4.0 long, 3.0 wide, 2.1 high; red-brown, slightly darker at margins. Sternum 2.3 long, 1.8 wide; dark brown. Abdomen 3.9 long, 2.6 wide, 4.7 high whitish with a dark gray pattern (Figure 158). AME diameter 0.22; whitish with a dark gray pattern. PME 0.58, PLE 0.73, ALE 0.91 times one AME diameter. AME separation 0.45 times their diameter, PME separation 1.00 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 0.44 times one ALE diameter. Clypeus height 2.27 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present and conspicuous. Legs red brown, without annuli. Leg and pedipalp lengths of male described above:
FIGURES 176–179.—*Pismo haden* Chamberlin and Ivie: 176, female from Washington, epigynum; 177, female from Washington, pedipalpal claw; 178, male from Washington, tarsal claw I; 179, female from Washington, tarsal claw I.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>9.6</td>
<td>8.4</td>
<td>6.1</td>
<td>7.7</td>
<td>2.4</td>
</tr>
<tr>
<td>Patella</td>
<td>1.5</td>
<td>1.4</td>
<td>1.2</td>
<td>1.3</td>
<td>0.7</td>
</tr>
<tr>
<td>Tibia</td>
<td>10.5</td>
<td>9.3</td>
<td>5.7</td>
<td>7.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>10.8</td>
<td>9.8</td>
<td>6.4</td>
<td>3.6</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.5</td>
<td>3.2</td>
<td>1.9</td>
<td>2.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>35.9</td>
<td>32.1</td>
<td>21.3</td>
<td>22.8</td>
<td>5.3</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.40 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.87.

**Female** (same locality than male): Total length 7.4. Cephalothorax 3.4 long, 2.6 wide, 2.0 high; brown, slightly darker at margins. Sternum 2.1 long, 2.0 wide; dark brown. Abdomen 3.7 long, 2.9 wide, 4.2 high; whitish with a dark gray pattern (Figures 164, 165). AME diameter 0.20, PME 0.75, PLE 0.85, ALE 0.90 times one AME diameter. AME separation 0.50 times their diameter, PME separation 1.00 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 0.56 times one ALE diameter. Clypeus height 1.90 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files absent. Legs brown, without annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>6.3</td>
<td>5.8</td>
<td>4.5</td>
<td>5.9</td>
<td>1.3</td>
</tr>
<tr>
<td>Patella</td>
<td>1.2</td>
<td>1.1</td>
<td>1.0</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Tibia</td>
<td>6.6</td>
<td>5.9</td>
<td>3.7</td>
<td>5.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>7.2</td>
<td>5.6</td>
<td>3.0</td>
<td>5.2</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.7</td>
<td>2.4</td>
<td>1.6</td>
<td>2.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>24.0</td>
<td>20.8</td>
<td>13.8</td>
<td>19.8</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.85 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.89. Epigynum as in Figures 161–163, 166–168, 176.

**Variation.**—Male cephalothorax ranges in length from 3.0 to 4.0, female from 2.2 to 4.6. The number of tibial retrolateral trichobothria of the male palp varies between five and six. Variation in cheliceral striae in two different males can be seen in Figures 181, 182, 184, 185. Some females show subtle
cheliceral striae (Figures 180, 183).

Figures 186-188.—*Pimoa haden* Chamberlin and Ivie, spinnerets, female from Washington: 186, ALS; 187, PMS; 188, PLS.

Figure 189.—Distributions of *Pimoa curvata* Chamberlin and Ivie (inverted open triangles), *P. jellisoni* (Gertsch and Ivie) (closed upright triangles), *P. haden* Chamberlin and Ivie (squares), and *P. breviata* Chamberlin and Ivie (circles).
FIGURES 190-194. — *Pimoa jellisoni* (Gertsch and Ivie), male from Idaho: 190, palp, ventral; 191, same, dorsal; 192, same, apical; 193, pedipalp (cymbium removed), ectal; 194, male from Washington, abdomen, dorsal. (Scale lines: 0.5 mm, except 194, 1.0 mm.)

Lake, N of Lead Point (48°55'N, 117°35'W), May 1968 (W. Ivie, AMNH), 7♀; Cedar Lake, N of Lead Point (48°55'N, 117°35'W), 1–10 Jun 1968 (W. Ivie, AMNH), 1♀; Cedar Lake (48°55'N, 117°36'W), 10 Sep 1963 (J. and W. Ivie, AMNH), 2♂, 2♀.

**DISTRIBUTION.** — Northern Idaho, northeastern Washington, northwestern Montana, and their bordering region of Canada (Figure 189).

*Pimoa jellisoni* (Gertsch and Ivie)

**FIGURES 189–217**

Labulla jelliconi. — Roewer, 1942:577 [lapsus calami].

Labulla ellisoni. — Fage, 1946:387 [lapsus calami].


**DIAGNOSIS.** — Male very similar to its sister species *haden*, but can be distinguished by a slimmer palpal femur (Figure 193), which lacks the cluster of spines characteristic of *haden*. Females are difficult to distinguish from *haden* in the absence of males. Although the epigynum seems to be quite variable (Figures 195–203) it is usually less protruding (more parallel to
FIGURES 195-209.—*Pimoa jellisoni* (Gertsch and Ivie), female: 195, holotype, ventral; 196, same, dorsal; 197, same, lateral; 198, female from Montana, ventral; 199, same, dorsal; 200, same, lateral; 201, female from Montana, ventral; 202, same, dorsal; 203, same, lateral; 204, female from Washington, abdomen, dorsal; 205, female from Idaho, abdomen, dorsal; 206, female from Washington, epigynum, cleared, ventral; 207, same, dorsal; 208, same, lateral; 209, cephalothorax, frontal. (Scale lines: 0.5 mm, except 204, 205, 209, 1.0 mm.)
FIGURES 210-217.—*Pimela jellisoni* (Gertsch and Ivie), male from Idaho: 210, palp, ventral; 211, palp, dorsoectal closeup; 212, PCS and cymbial denticulated process; 213, cymbial denticulated process; 214, conductor and median apophysis; 215, conductor and median apophysis; 216, 217, conductor, closeups.
the abdominal wall) than in *haden*.

**Male** (from Lost Lake, Idaho): Total length 8.6. Cephalothorax 4.0 long, 3.1 wide, 2.0 high; brown, slightly darker at margins. Sternum 2.4 long, 1.9 wide; brown. Abdomen 4.2 long, 3.3 wide, 5.1 high; whitish with dark gray pattern. AME diameter 0.20. PME 0.90, PLE 0.90, ALE 0.90 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.75 times their diameter. PME-PLE separation 1.11 times one PME diameter, AME-ALE separation 1.11 times one ALE diameter. Clypeus height 2.50 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present. Legs red-brown, without annuli. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>10.8</td>
<td>9.5</td>
<td>7.0</td>
<td>8.5</td>
<td>2.8</td>
</tr>
<tr>
<td>Patella</td>
<td>1.5</td>
<td>1.5</td>
<td>1.2</td>
<td>1.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Tibia</td>
<td>11.3</td>
<td>10.0</td>
<td>6.1</td>
<td>8.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>13.7</td>
<td>11.2</td>
<td>7.0</td>
<td>9.0</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.6</td>
<td>3.3</td>
<td>2.3</td>
<td>2.7</td>
<td>1.2</td>
</tr>
<tr>
<td>Total</td>
<td>40.9</td>
<td>35.5</td>
<td>32.6</td>
<td>29.7</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.70 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.93. Pedipalp as in Figures 190–193, 210–217.

**Female** (same locality as male): Total length 8.8. Cephalothorax 4.5 long, 3.4 wide, 2.3 high; brown, slightly darker at margins. Sternum 2.5 long, 1.8 wide; dark brown. Abdomen 4.5 long, 3.3 wide, 3.5 high; whitish with dark gray pattern. AME diameter 0.20. PME 0.90, PLE 0.90, ALE 0.90 times one AME diameter. AME separation 0.7 times their diameter, PME separation 1.00 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 0.67 times one ALE diameter. Clypeus height 2.40 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present, but inconspicuous and ridges scale-like. Legs brown, without annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>8.0</td>
<td>7.3</td>
<td>5.6</td>
<td>7.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Patella</td>
<td>1.7</td>
<td>1.6</td>
<td>1.3</td>
<td>1.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Tibia</td>
<td>8.3</td>
<td>7.5</td>
<td>4.8</td>
<td>6.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>7.8</td>
<td>7.2</td>
<td>5.2</td>
<td>6.6</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.3</td>
<td>2.8</td>
<td>2.1</td>
<td>2.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>29.1</td>
<td>26.4</td>
<td>19.0</td>
<td>24.3</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.78 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.88. Epigynum as in Figures 195–203, 206–208.

**Variation.**—Male cephalothorax ranges in length from 2.9 to 4.1, female from 3.0 to 4.5. Some specimens have a particularly dark coloration. The morphology of the epigynum is quite variable (Figures 195–203).

**Additional Material Examined.**—UNITED STATES: IDAHO: Adams Co.: 7 mi (11.2 km) NE of Council (44°48'N, 116°22'W), 5 Aug 1943 (W. Ivie, AMNH), 4♂, 1♀; summit 7 mi (11.2 km) NE of Council (44°49'N, 116°24'W), 7 Oct 1944 (W. Ivie, AMNH), 2♀; Evergreen Camp, Upper Weiser river (44°52'N, 116°22'W), 2 Jul 1943 (W. Ivie, AMNH), 3♂; 6 Aug 1943 (W. Ivie, AMNH), 1♂, 1♀; Boise Co.: Lost Lake, below dam (44°49'N, 116°W), 20 Aug 1936 (W. Ivie, AMNH), 15♀; 7 Aug 1943 (W. Ivie, AMNH), 1♂, 2♀; Clearwater Co.: Greer (46°24'N, 116°04'W), 30 Aug 1959 (W. J. Gertsch and V. Roth, AMNH), 1♀; Idaho Co.: Clearwater Creek, nr Kooskiia (46°20'N, 115°W), 23 Aug 1940 (W. Ivie, AMNH), 2♀; Mud Cr. Jct, 25 Nov 1978, with grylloblattids on snow (AMNH), 2♂, 2♀; Latah Co.: Moscow Mts., Moscow, Jun 1936 (C. B. Philips, AMNH), 1♀; Valley Co.: NE of McCall (44°55'N, 116°04'W), 31 May 1944 (W. Ivie, AMNH), 2♀. MONTANA: Granite Co.: Rock Creek Rec. Area, Kitchen Gulch, Lolo Natl. Forest, 23 Sep 1950, (V. Roth, AMNH), 3♀; Ravalli Co.: Forest Service, Garbee Pt., East Fork, 24 Jul 1944 (Jellison, AMNH), 1♀. WASHINGTON: Spokane Co.: Newman Lake, 29 May 1937 (M. H. Hatch, CAS), 1♀; Spokane Mt., 25 mi (40 km) NE of Spokane, 28 Aug 1959 (V. Roth and W. J. Gertsch, AMNH), 8♂, 17♀; Mt. Spokane, 30 May 1937 (M. H. Hatch, CAS), 1♀.

**DISTRIBUTION.**—Idaho, northeastern Washington, and western Montana (Figure 189).

**Pimoa gandhii**, new species

**Figures** 218–223


**Note.**—The correct locality spelling is Pahalgam, Kashmir South (34°00’N, 75°23’E).

**Etymology.**—The species epithet is a patronym in honor of Mohandas K. Gandhi.

**Diagnosis.**—Males can be distinguished by having the denticulated cymbial process in a relatively basal position, with only three or four denticles (Figure 218). The distal end of the CDP is broader than in *sinuosa* and *nematoida*. Females can be distinguished having a lateral epigynal fold with "lips" of approximately the same width and fused copulatory ducts (Figures 224–229).

**Male** (holotype): Cephalothorax 3.7 long, 2.7 wide, 1.7 high; yellowish brown with dark gray margins and central longitudinal line. Sternum 1.90 long, 1.49 wide; dark gray. AME diameter 0.18. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.55 times their diameter, PME separation 0.55 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 1.00 times one ALE diameter. Clypeus height 2.00 times one AME diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files present. Legs reddish brown with dark gray annuli. Leg and pedipalp lengths of male described above:
Figures 218-223. — *Pimoa gandhii*, new species, male (holotype): 218, palp, ventral; 219, same, apical; 220, same, dorsal; 221, same, ectal; 222, cephalothorax, frontal; 223, same, dorsal. (Scale lines: 0.5 mm, except 222, 223, 1.0 mm.)
FIGURES 224–231.—Pimoo gandhii, new species, female (paratype): 224, epigynum, ventral; 225, same, lateral; 226, epigynum, cleared, lateral; 227, same, anterior; 228, same, dorsal; 229, same, ventral; 230, abdomen, dorsal; 231, same, lateral. (Scale lines: 0.5 mm, except 230, 231, 1.0 mm.)

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>7.1</td>
<td>6.1</td>
<td>4.3</td>
<td>5.4</td>
<td>1.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.3</td>
<td>1.3</td>
<td>0.9</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Tibia</td>
<td>7.2</td>
<td>6.1</td>
<td>3.7</td>
<td>–</td>
<td>0.5</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>7.1</td>
<td>6.0</td>
<td>4.0</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.9</td>
<td>2.2</td>
<td>1.5</td>
<td>–</td>
<td>0.9</td>
</tr>
<tr>
<td>Total</td>
<td>25.5</td>
<td>21.7</td>
<td>14.4</td>
<td>–</td>
<td>2.8</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.92 times length of cephalothorax, with a row of thick prolateral spines. Legs covered with long setae. Metatarsus I trichobothrium 0.91. Pedipalp as in Figures 218–221.

Female (paratype): Cephalothorax 3.1 long, 2.1 wide, 1.8 high; yellowish brown with dark gray margins and central longitudinal line. Sternum 1.4 long, 1.2 wide; dark gray. Abdomen 4.3 long, 2.5 wide, 2.7 high; light brown with very dark gray pattern (Figures 230, 231). AME diameter 0.15. PME 1.29, PLE 1.14, ALE 1.00 times one AME diameter. AME separation 0.86 times their diameter, PME separation 0.66 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 0.77 times one ALE diameter. Clypeus height 2.43 times one AME diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files scale-like. Legs light brown with dark gray annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>4.7</td>
<td>4.1</td>
<td>3.2</td>
<td>3.7</td>
<td>1.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.2</td>
<td>1.1</td>
<td>0.9</td>
<td>0.9</td>
<td>0.3</td>
</tr>
<tr>
<td>Tibia</td>
<td>4.7</td>
<td>3.9</td>
<td>2.5</td>
<td>–</td>
<td>0.7</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>4.1</td>
<td>3.5</td>
<td>2.6</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.0</td>
<td>1.7</td>
<td>1.3</td>
<td>–</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>16.7</td>
<td>14.3</td>
<td>10.5</td>
<td>–</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.51 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.89. Epigynum as in Figures 224–229.
FIGURE 232.—Distributions of Pimoa gandhii, new species (closed upright triangle), P. crispa (Fage) (open upright triangle), P. sinuosa, new species (square), P. nematoide, new species (closed inverted triangle), P. indiscrela, new species (circle), and P. anatolka, new species (open inverted triangle).

VARIATION.—Female cephalothorax ranges in length from 2.7 to 3.1.

ADDITIONAL MATERIAL EXAMINED.—None.

DISTRIBUTION.—Known only from the type locality in the South Kashmir region of India (Figure 232).

Pimoa crispa (Fage)
Figures 232-247

Metella crispa Fage. 1946:385-387, figs. 3, 4 [♂, ♀].
Acrometa crispa.—Wunderlich, 1979:413.
Pimoa crispa.—Hormiga, 1993:534.

TYPES.—One male and one female syntypes (included in the same vial there are two adult male pedipalps and one epigynum), label states “Metella crispa Fage Grotte de Moila Swallet Inde Types! Chakrata Tahsil. Dehra-Dun district.” Deposited in MNHM. Examined.

NOTE.—A more detailed description of the type locality is given in Fage (1946:382, 387): India, Chakrata, Dehra Dun district (30°46'N, 77°47'E), 2550 m alt. E.A. Glennie Coll.. Type locality: “Toad Hole; Moila Caves; Moila Swallet; Surflet Pot; 4♂, nombreuses ♀ et nombreux jeunes.” The rest of the syntype series is apparently lost.

DIAGNOSIS.—Male palp with a large and broad lateral cymbial denticulated process, with numerous denticles. The paracymbium is short and procurved. Pedipalpal tibia at least longer than twice its width (Figures 233). Epigynum with lateral fold. Copulatory ducts with a single turn and not fused (Figures 244-247).

Male (syntype): Cephalothorax 3.9 long, 2.8 wide, 1.9 high; very light brown. Sternum 2.3 long, 1.8 wide; very light brown. Abdomen 3.7 long; yellowish. AME diameter 0.16. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.80 times their diameter. PME-PLE separation 1.80 times one PME diameter, AME-ALE separation 1.60 times one ALE diameter. Clypeus height 3.00 times one ALE diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files present. Legs very light brown. Leg and pedipalp lengths of male described above:
Figures 233–238.—*Pimoa crispa* (Fage), male (syntype): 233, palp, ventral; 234, same, ectal; 235, same, dorsal; 236, detail cymbial process, dorsal; 237, cephalothorax, dorsal; 238, same, frontal. (Scale lines: 0.5 mm, except 237, 238, 1.0 mm.)

Femur I 3.31 times length of cephalothorax. Legs covered with long setae. Pedipalp as in Figures 233–236.

*Female* (syntype): Cephalothorax 4.9 long, 3.4 wide, 2.7 high; reddish brown. Sternum 2.7 long, 2.0 wide; reddish brown. Abdomen 7.3 long, 5.3 wide, 5.6 high; whitish. AME diameter 0.16. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.60 times their diameter, PME

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>12.9</td>
<td>–</td>
<td>8.8</td>
<td>–</td>
<td>1.6</td>
</tr>
<tr>
<td>Patella</td>
<td>1.7</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.8</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Femur I 3.31 times length of cephalothorax. Legs covered with long setae. Pedipalp as in Figures 233–236.
separation 1.00 times their diameter. PME-PLE separation 1.80 times one PME diameter, AME-ALE separation 1.80 times one ALE diameter. Clypeus height 4.20 times one AME diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files absent. Legs reddish brown. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>10.6</td>
<td>10.2</td>
<td>10.1</td>
<td>9.4</td>
<td>2.3</td>
</tr>
<tr>
<td>Patella</td>
<td>1.9</td>
<td>1.9</td>
<td>1.6</td>
<td>1.7</td>
<td>0.6</td>
</tr>
<tr>
<td>Tibia</td>
<td>11.8</td>
<td>10.9</td>
<td>10.8</td>
<td>9.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>12.1</td>
<td>11.3</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>2.6</td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>6.8</td>
</tr>
</tbody>
</table>
Femur I 2.16 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.95. Epigynum as in Figures 239-242.

ADDITIONAL MATERIAL EXAMINED.—None.

DISTRIBUTION.—Known only from its type locality in northern India (Figure 232).

*Pimoa indiscreta*, new species

**FIGURES 248-255.**—*Pimoa indiscreta*, new species, female (holotype): 248, epigynum, ventral; 249, same, dorsal; 250, same, lateral; 251, epigynum, cleared, ventral; 252, same, dorsal; 253, same, lateral; 254, abdomen, dorsal; 255, same, lateral. (Scale lines: 0.5 mm, except 254, 255, 1.0 mm.)

*Pimoa indiscreta*, new species

**FIGURES 248-255.**

**TYPES.**—Female holotype, labels state “India: W. Bengal, Debrepansi, 10 mi (16 km) W Ghum, 2010 m, X-22-1691 [sic.]” and “colls. E.S. Ross, D. Cavagnaro.” Deposited in CAS.

ETYMOLOGY.—The species epithet is derived from the Latin *indiscretus* (unseparated, closely connected) and refers to the fusion of the copulatory ducts.

DIAGNOSIS.—Female with fused copulatory ducts (Figure 251). *Pimoa indiscreta* can be distinguished from *gandhii* because of the narrow dorsal epigynal lateral lip of the former (Figure 250).

**Male:** Unknown.

**Female** (holotype): Total length 7.2. Cephalothorax 3.0 long, 2.4 wide, 1.7 high; brown. Sternum 1.6 long, 1.5 wide; dark brown. Abdomen 4.4 long, 3.5 wide, 4.2 high; whitish
with gray pattern (Figures 254, 255). AME diameter 0.20. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.80 times their diameter. PME-PLE separation 0.80 times one PME diameter, AME-ALE separation 0.60 times one ALE diameter. Clypeus height 2.20 times one AME diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files absent. Legs brown, with slightly marked gray annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>5.8</td>
<td>4.9</td>
<td>3.3</td>
<td>4.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Patella</td>
<td>1.2</td>
<td>1.0</td>
<td>0.9</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>6.2</td>
<td>4.8</td>
<td>2.8</td>
<td>–</td>
<td>0.8</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>5.5</td>
<td>4.3</td>
<td>3.0</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.5</td>
<td>1.8</td>
<td>1.3</td>
<td>–</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>21.2</td>
<td>16.8</td>
<td>11.3</td>
<td>–</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.93 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.83. Epigynum as in Figures 248–253.

ADDITIONAL MATERIAL EXAMINED.—None.

DISTRIBUTION.—Known only from its type locality in the West Bengal province of India (Figure 232).

**Pimoa sinuosa, new species**  
FIGURES 256–284, 232

TYPES.—Male holotype and six female paratypes from Nepal, Gandaki zone, Kaski Dist., Banthati, Rhododendron forest, about 2500 m, 26 Oct 1985, J. Coddington col. Deposited in USNM.

ETYMOLOGY.—The species epithet is from the Latin *sinuosa* (full of bendings, windings) and refers to shape of the copulatory duct.

DIAGNOSIS.—Males have a characteristic group of spines in the proximal third of femur I (Figure 265). Females have a lateral epigynal fold but without pronounced lips; in lateral view, the epigynum distal end is wider than half of its width at the base (Figure 268). The conformation of the copulatory duct is also diagnostic (Figures 272–274).

**Male** (Holotype): Total length 8.0. Cephalothorax 3.8 long, 3.4 wide, 1.9 high; brown with gray margins and a dark gray stripe between the ocular area and the thoracic fovea (Figure 262). Sternum 2.2 long, 1.9 wide; dark gary-brown. Abdomen 4.2 long, 2.7 wide, 2.3 high; whitish with dark gray (almost black) pattern (Figures 263, 264). AME diameter 0.19. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.75 times their diameter. PME-PLE separation 1.00 times one PME diameter, ALE-ALE separation 0.75 times one ALE diameter. Clypeus height 2.50 times one ALE diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files present. Legs brown with dark gray annuli. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>10.4</td>
<td>10.0</td>
<td>6.7</td>
<td>8.6</td>
<td>1.3</td>
</tr>
<tr>
<td>Patella</td>
<td>1.5</td>
<td>1.6</td>
<td>1.2</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>10.7</td>
<td>10.0</td>
<td>5.8</td>
<td>–</td>
<td>0.6</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>11.9</td>
<td>11.1</td>
<td>6.7</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>4.0</td>
<td>3.5</td>
<td>2.1</td>
<td>–</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>38.5</td>
<td>36.2</td>
<td>22.5</td>
<td>–</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.73 times length of cephalothorax, with numerous thick and long spines in the ventral, prolateral, and retrolateral side of the proximal third. Legs covered with long setae. Metatarsus I trichobothrium 0.87. Pedipalp as in Figures 256–259.

**Female** (paratype): Total length 9.7. Cephalothorax 4.5 long, 3.4 wide, 2.3 high; light brown with dark gray margins and a dark gray stripe between the ocular area and the thoracic fovea (Figure 271). Sternum 2.48 long, 2.01 wide; dark brown. Abdomen 5.7 long, 4.6 wide, 2.3 high; whitish with dark gray (almost black) pattern (Figure 269). AME diameter 0.26. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.80 times their diameter. PME-PLE separation 1.00 times one PME diameter, ALE-ALE separation 0.80 times one ALE diameter. Clypeus height 2.37 times one ALE diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files present (Figure 278). Legs brown with dark gray annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>9.7</td>
<td>8.6</td>
<td>6.1</td>
<td>7.9</td>
<td>1.7</td>
</tr>
<tr>
<td>Patella</td>
<td>1.7</td>
<td>1.5</td>
<td>1.3</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>10.0</td>
<td>8.6</td>
<td>5.3</td>
<td>7.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>9.8</td>
<td>8.4</td>
<td>5.7</td>
<td>7.3</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.4</td>
<td>2.7</td>
<td>1.9</td>
<td>2.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Total</td>
<td>34.6</td>
<td>29.8</td>
<td>20.3</td>
<td>26.3</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.15 times length of cephalothorax, with a group (less than a dozen) of thick prolateral spines in the proximal third. Legs covered with long setae. Metatarsus I trichobothrium 0.92. Epigynum as in Figures 266–268, 272–276.

VARIATION.—Female cephalothorax ranges in length from 2.8 to 4.5.

ADDITIONAL MATERIAL EXAMINED.—NEPAL: Kaski District, Gandaki Zone: Chomrung-Khuldi Ghar trail, 22 Oct 1985, montane forest, 2300 m (J.A. Coddington, USNM), 1q; Dobang, 23 Oct 1985, bamboo forest, about 2500 m (J.A. Coddington, USNM), 2q; Rhododendron bamboo forest near Khuldi Ghar, 22 Oct 1985, 2400 m (J.A. Coddington, USNM), 2q; Rhododendron bamboo forest near Khuldi Ghar, 23 Oct 1985, 2400 m (J.A. Coddington, USNM), 1q.

DISTRIBUTION.—Known only from the Gandaki zone in the Kaski district of Nepal (Figure 232).
FIGURES 256-265.—Pinwa sinuata, new species, male (holotype): 256, palp, ventral; 257, same, ectal; 258, same, dorsal; 259, same, detail base of cymbium, ectoventral; 260, cephalothorax, lateral; 261, same, frontal; 262, same, dorsal; 263, abdomen, dorsal; 264, same, lateral; 265, femur I, ectal. (Scale lines: 0.5 mm, except 260-265, 1.0 mm.)
FIGURES 266–274. — *Pimoa sinuosa*. new species, female (paratype): 266, epigynum, ventral; 267, same, dorsal; 268, same, lateral; 269, abdomen, dorsal; 270, cephalothorax, frontal; 271, same, dorsal; 272, epigynum, cleared, ventral; 273, same, lateral; 274, same, anterodorsal. (Scale lines: 0.5 mm, except 269–271, 1.0 mm.)
Figures 275–280.—*Pimia sinuosa*, new species, female from Nepal: 275, epigynum, apical; 276, epigynum, posterodorsal; 277, pedipalpal claw; 278, chelicera, ectal; 279, 280, cheliceral striae, closeups.
**Pimoa nematoide, new species**

**Figures** 285-289, 232

*Acrometa* sp. — Wunderlich, 1979:411, figs. 18, 19 [♂].

**Types.** — Male holotype and one male paratype from Nepal. Labels state “Linyphiidae: Pimoinae sp., 1♂ Nepal, 57; Chordung. Martens leg.” (holotype) and “Senck. Mus 29974 Frankfurt/Main. Acrometa sp. 1♂ Nepal. Martens leg. Wunderlich det. 1979” (paratype). Deposited in SM.

**Etymology.** — The species epithet is derived from the Greek *nematos* (thread), hence *nematoide* thread-like, and refers to the shape of the embolus of this species.

**Diagnosis.** — The male can be distinguished from other...
Asian *Pimoa* by its very long and filiform embolus and PEP (similar to *sinuosa*, but longer) and by the sclerotized cymbial region between the paracymbium and the ectal margin of the cymbium (Figures 285, 286). The globular shape of the tegulum is also diagnostic.

**Male** (holotype): Total length 4.6. Cephalothorax 2.1 long, 1.7 wide, 1.2 high; yellowish brown. Sternum 1.3 long, 1.1 wide. Abdomen 2.1 long, 1.6 wide, 2.0 high; very light brown. AME diameter 0.11, PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.30 times their diameter, PME separation 0.71 times their diameter. PME-PLE separation 0.86 times one PME diameter, AME-ALE separation 0.71 times one ALE diameter. Clypeus height 2.71 times one AME diameter. Chelicerae with three (four) prolateral and three (two) retrolateral teeth. Cheliceral stridulating files present. Legs light brown without annuli. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>3.2</td>
<td>3.0</td>
<td>2.4</td>
<td>3.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Patella</td>
<td>–</td>
<td>0.7</td>
<td>0.6</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Tibia</td>
<td>–</td>
<td>–</td>
<td>2.1</td>
<td>2.8</td>
<td>0.3</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>–</td>
<td>–</td>
<td>2.1</td>
<td>2.8</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>–</td>
<td>–</td>
<td>0.9</td>
<td>1.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>–</td>
<td>–</td>
<td>8.1</td>
<td>10.4</td>
<td>2.1</td>
</tr>
</tbody>
</table>

Femur I 1.52 times length of cephalothorax, with a group
(about a dozen) of thick and long ventral spines in the medial third. Pedipalp as in Figures 285–289.

Female: Unknown.

Variation.—Male cephalothorax ranges in length from 1.9 to 2.1. The number of prolateral cheliceral teeth varies from three to four and the retrolateral from two to three. The paratype has the legs covered with long setae, the absence of setae in the holotype seems to be a preservation artifact.

Distribution.—Known only from the type locality in Nepal (Figure 232).

**Pimoa anatolica**, new species

*Figures* 290–300, 232

Types.—Female holotype, label states “China, Tsuyung Yunnan Nov. 10, 1944. Mont A. Cazier.” Deposited in AMNH.

Etymology.—The species epithet is derived from the Greek *anatole*, east.

Diagnosis.—Epigynal lateral lips clearly marked and wide (Figure 292). Distal end of the epigynum (in lateral view) narrower than half the width of the base. Copulatory duct with double switch (Figure 297).

Male: Unknown.

Female (holotype): Total length 7.5. Cephalothorax 3.1 long, 2.4 wide, 1.7 high; dark brown, darker at margins. Sternum 1.7 long, 1.5 wide; dark brown. Abdomen 4.3 long, 3.6 wide, 4.8 high; whitish with dark gray pattern (Figures 295, 296). AME diameter 0.19. PME 1.00, PLE 1.00, ALE 1.00 times one AME diameter. AME separation 0.67 times their diameter, PME separation 0.67 times their diameter. PME-PLE separation 0.83 times one PME diameter, AME-ALE separation 0.50 times one ALE diameter. Clypeus height 2.00 times one AME diameter. Chelicerae with three prolateral and three retrolateral teeth. Cheliceral stridulating files absent. Legs brown with dark gray annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>5.6</td>
<td>4.8</td>
<td>3.1</td>
<td>4.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.2</td>
<td>1.2</td>
<td>0.8</td>
<td>0.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Tibia</td>
<td>5.7</td>
<td>5.1</td>
<td>2.7</td>
<td>4.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>4.7</td>
<td>4.3</td>
<td>2.5</td>
<td>3.5</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.2</td>
<td>2.1</td>
<td>1.2</td>
<td>1.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>19.4</td>
<td>17.5</td>
<td>10.3</td>
<td>13.9</td>
<td>3.3</td>
</tr>
</tbody>
</table>

Legs 1243. The right leg I is shorter than the left (17.3 total length; Metatarsus I trichobothrium 0.86; right femur I 1.6 times length of cephalothorax), probably due to loss and posterior regeneration. Femur I 1.8 times length of cephalothorax. Metatarsus I trichobothrium 0.89. Epigynum as in Figures 290–292, 297–300.

Distribution.—Known only from the type locality in western China (Figure 232).
FIGURES 290-300.—*Pimoa anatolica*, new species, female (holotype): 290, epigynum, ventral; 291, same, dorsal; 292, same, lateral; 293, cephalothorax, dorsal; 294, same, frontal; 295, abdomen, dorsal; 296, same, lateral; 297, epigynum, cleared, ventral; 298, same, lateral; 299, same, anterior; 300, same, anterolateral. (Scale lines: 0.5 mm, except 293-296, 1.0 mm.)
**Pimoa altioculata** (Keyserling)

*Figures 7–9, 301–337*


*Labulla utahana* Gertsch and Ivie, 1936:16, fig. 39 [♀] [female holotype from Salt Lake City, Utah, AMNH; examined]. [New synonymy.]

*Pimoa utahana.*—Chamberlin and Ivie, 1943:12.

*Labulla alticola.*—Fage, 1946:387 [lapsus calami].


*Acrometa alticola.*—Wunderlich, 1979:411 et passim, figs. 12–17 [♂♀].

[Type specimens deposited in BMNH. Examined.]

**Diagnosis.**—Male with apophysis in pedipalpal trochanter (Figures 307, 308) and numerous denticles in the cymbial denticulated process. The femur I has a group of thick spines (10 or more) in the center of the ventral-prolateral side (Figure 309). Only *P. petita* has also an apophysis in the trochanter (somewhat smaller), but its cymbial process has only two or three denticles. Female with epigynum distal end projected into a small plate heavily sclerotized, which bears the copulatory openings (Figures 312, 317, 330, 331).

**Male** (from Grays River, “Swede Park.” Wahkiakum Co., Washington, 25 Oct 1984, 60 ft. R. Crawford, UW): Total length 6.5. Cephalothorax 3.0 long, 2.4 wide, 1.7 high; light brown, darker at the margins. Sternum 1.7 long, 1.4 wide; brown. Abdomen 3.2 long, 2.6 wide, 3.1 high; whitish with a dark gray pattern (Figures 305, 306). AME diameter 0.20. PME 0.80, PLE 0.70, ALE 0.80 times one AME diameter. AME separation 0.20 times their diameter, PME separation 0.63 times their diameter. PME-PLE separation 0.75 times one PME diameter, AME-AME separation 0.50 times one AME diameter. Clypeus height 1.60 times one AME diameter. Chelicerae with three prolaral and two (three) retrolateral teeth. Cheliceral stridulating files present (Figure 326). Legs brown with dark gray annuli. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>6.2</td>
<td>4.6</td>
<td>3.5</td>
<td>4.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.0</td>
<td>1.0</td>
<td>0.8</td>
<td>0.9</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>5.2</td>
<td>4.7</td>
<td>3.0</td>
<td>4.8</td>
<td>0.4</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>5.6</td>
<td>4.6</td>
<td>3.2</td>
<td>4.2</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.1</td>
<td>2.1</td>
<td>1.3</td>
<td>1.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>20.1</td>
<td>17.0</td>
<td>11.8</td>
<td>15.2</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 2.07 times length of cephalothorax, with a group of thick spines (10 or more) in the center of the ventral-prolateral side (Figure 309). Legs covered with long setae. Metatarsus I trichobothrium 0.85. Pedipalp as in Figures 301–304, 310, 311, 320–325, with retrolateral apophysis in the trochanter (Figures 307, 308).

**Female** (same locality than male): Total length 8.8. Cephalothorax 3.9 long, 2.9 wide, 2.9 high; light brown darker at the margins. Sternum 1.7 long, 2.1 wide; dark brown. Abdomen 4.7 long, 3.1 wide, 3.3 high; light gray with a dark gray pattern (Figures 318, 319). AME diameter 0.20. PME 0.90, PLE 0.90, ALE 1.10 times one AME diameter. AME separation 0.70 times their diameter, PME separation 0.78 times their diameter. PME-PLE separation 0.89 times one PME diameter, AME-ALE separation 0.45 times one ALE diameter. Clypeus height 2.30 times one AME diameter. Chelicerae with three prolaral and three retrolateral teeth. Cheliceral stridulating files present. Legs light brown with dark brown annuli.

Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>6.5</td>
<td>5.5</td>
<td>4.4</td>
<td>5.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Patella</td>
<td>1.5</td>
<td>1.4</td>
<td>1.1</td>
<td>1.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>6.5</td>
<td>5.6</td>
<td>3.7</td>
<td>5.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>6.2</td>
<td>5.3</td>
<td>3.9</td>
<td>5.1</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.9</td>
<td>2.2</td>
<td>1.7</td>
<td>2.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Total</td>
<td>23.6</td>
<td>20.0</td>
<td>14.8</td>
<td>19.4</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.67 times length of cephalothorax, with a group of thick spines (less numerous than in the male) in the center of the ventral-prolateral side. Legs covered with long setae. Metatarsus I trichobothrium 0.85. Epigynum as in Figures 312–317, 328–331.

**Variation.**—Male cephalothorax ranges in length from 2.1 to 3.4, female from 2.1 to 4.0. The number of retrolateral cheliceral teeth varies from two to three in both sexes. Some females present heavily sclerotized setal bases on the ventral side of the abdomen. These setal bases appear as dark dots on both sides of the abdomen, posterior to the epigynum.

**Additional Material Examined** (County records only).—CANADA: BRITISH COLUMBIA. UNITED STATES: ALASKA; CALIFORNIA: Siskiyou; OREGON: Benton, Clackamas, Clatsop, Coos, Douglas, Hood River, Jackson, Jefferson, Josephine, Lane, Lincoln, Marion, Multnomah, Washington, Yamhill; WASHINGTON: Clallam, Clark, Cowlitz, Grays Harbor, Island, Jefferson, King, Kitsap, Lewis, Mason, Pacific, Pierce, San Juan, Skagit, Skamania, Snohomish, Thurston, Wahkiakum, Whatcom.

**Distribution.**—Western North America, from northern California through Alaska (Figure 337). There is a record of a single specimen from Salt Lake City, Utah (Gertsch and Ivie, 1936) which would be the most eastern record for this species. The Utah specimen was considered to be a different species by its authors. I cannot tell it apart from *altioculata*, and therefore is treated here as junior synonym. This isolated record is provisionally considered as dubious, until more specimens are collected from the mentioned area.
FIGURES 301-309.—*Pimoa alticulata* (Keyserling), male: 301, male from Oregon, palp, ventral; 302, same, apical; 303, same, cymbium (basal haematodocha removed); 304, same, dorsal; 305, male from Oregon, abdomen, dorsal; 306, male from Washington, abdomen, dorsal; 307, male from Oregon, trochanteral apophysis, mesal; 308, same, ectal; 309, male from Washington, femur I, dorsomesal. (Scale lines: 0.5 mm, except 305, 306, 1.0 mm and 309, 2.0 mm.)
FIGURES 310, 311.—*Pimoa alticulata* (Keyserling), male from Washington, expanded palp: 310, anteroventral; 311, apical. (Scale line: 1.0 mm.)
FIGURES 312–319.—*Pimela alioculata* (Keyserling), female: 312, female from Washington, epigynum, ventral; 313, same, dorsal; 314, same, lateral; 315, same epigynum, cleared, lateral; 316, same, ventral; 317, same, dorsal; 318, female from Alaska, abdomen, dorsal; 319, female from Washington, abdomen, dorsal. (Scale lines: 0.5 mm, except 318, 319, 1.0 mm.)
FIGURES 320–327.—Pimoe altioculata (Keyserling): 320, male from Alaska, palp, ventral; 321, same male, conductor and median apophysis; 322, same male, PCS and cymbial denticulated process, apical; 323, male from Oregon, cymbial denticulated process, ventral; 324, male from Alaska, cymbial denticles; 325, same male, palp, ectal; 326, male from Oregon, chelicera, ectal; 327, cheliceral striae, closeup.
FIGURES 328-332.—*Pimoa altioculata* (Keyserling): 328, female from Oregon, epigynum, ventral; 329, same female, epigynum, dorsal; 330, female from Oregon, epigynum, ventral; 331, same female, epigynum, posterodorsal; 332, same female, colulus.
FIGURES 333-336.—*Pimoea altiocola* (Keyserling), spinnerets, female from Oregon: 333, spinneret group; 334, ALS; 335, PMS; 336, PLS.
**Pimoa petita, new species**

**Figures 338-344, 117**


**Etymology.**—The specific epithet is from the Catalan petit (small) and refers to the small size of this species.

**Diagnosis.**—Male with a retrolateral apophysis in the trochanter (Figure 343) and only two or three denticles in the cymbial process. Only *P. altioculata* also has an apophysis in the trochanter, but usually it is of larger body size and has numerous denticles in the cymbial process.

**Male (Holotype):** Total length 4.83. Cephalothorax 2.33 long, 1.95 wide, 1.40 high; light brown, with a light gray longitudinal line and margins. Sternum 1.21 long, 1.21 wide; gray. Abdomen 2.33 long, 1.86 wide, 1.95 high; very light brown with a dark gray pattern. AME diameter 0.12. PME 1.17, PLE 1.17, ALE 1.00 times one AME diameter. AME separation 0.67 times their diameter, PME separation 0.71 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 0.50 times one ALE diameter. Clypeus height 2.50 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present and conspicuous. Legs light brown with light gray annuli. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>4.5</td>
<td>3.7</td>
<td>2.9</td>
<td>3.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Patella</td>
<td>0.8</td>
<td>0.8</td>
<td>0.7</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Tibia</td>
<td>4.7</td>
<td>3.8</td>
<td>2.4</td>
<td>3.4</td>
<td>0.2</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>4.5</td>
<td>3.5</td>
<td>2.5</td>
<td>3.3</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.0</td>
<td>1.8</td>
<td>1.3</td>
<td>1.6</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td>16.5</td>
<td>13.6</td>
<td>9.8</td>
<td>12.6</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.96 times length of cephalothorax, with a group of thick spines (around 10) in the center of the ventral-prolateral side. Metatarsus I trichobothrium 0.85. Pedipalp with retrolateral apophysis in the trochanter, as in Figures 338-343.

**Female:** Unknown.

**Variation.**—The right and left pedipalps of the only specimen available present some differences. The PCS in the right pedipalp is quite different from the left one, in that the former has a constriction (Figure 342), and the tibia has two retrolateral trichobothria (while there is only one in the left one). Obviously one of the PCS is malformed. Because the PCS of the left palp is very similar to the one in its sister species *altioculata* I think that the right PCS is the malformed one.

**Additional Material Examined.**—None.

**Distribution.**—Known only from the type locality in the Yamhill County in northwestern Oregon (Figure 117). It is interesting to note that its sister species, *Pimoa altioculata*, can be also found in the type locality of *petita*. Although I did
collect altiocolata in Peavine Ridge, the type locality, I could not find petita.

**Pimoa breviata** Chamberlin and Ivie

_Figures 3-6, 345-367, 189_

*Pimoa breviata* Chamberlin and Ivie, 1943:11, fig. 16(r).—Brunsöli, 1975:13; 1983:231.—Roth, 1988:45.

**Types.**—Female holotype and two female paratypes, labels state "Pimoa breviata Chamberlin and Ivie $\varphi$ 122.43 NW Oregon: Canyon Creek So. of Roseburg September 9, 1935 Chamberlin & Ivie HOLOTYPE" and "Pimoa breviata Chamberlin and Ivie $\varphi$ 123.43 NW Oregon: Comstock September 9, 1935 Chamberlin and Ivie PARATYPE" (two females). Deposited in AMNH. Examined.

**Diagnosis.**—Male with embolus of approximately the same length as the PEP (measured from the embolus-PEP connection towards the distal end, Figure 346). Epigynum with heavily sclerotized distal margin, bearing two short dorsal plate projections, distant one from another no more than one
protection length. The dorsal plate projections of *laurea* and *edenticulata* are larger.

**Male** (from Bookings, Oregon): Total length 7.0. Cephalothorax 3.4 long, 2.5 wide, 2.1 high; light brown with a gray longitudinal line and margins. Sternum 1.7 long, 1.6 wide; dark brown. Abdomen 3.6 long, 2.2 wide, 3.0 high; whitish with a dark gray pattern (Figure 348). AME diameter 0.20. PME 1.00, PLE 0.80, ALE 1.00 times one AME diameter. AME separation 0.60 times their diameter. PME separation 0.60 times their diameter. PME-PLE separation 0.80 times one PME diameter, AME-ALE separation 0.50 times one ALE diameter. Clypeus height 1.60 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present. Legs brown with dark brown annuli. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>8.5</td>
<td>6.5</td>
<td>4.5</td>
<td>5.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Patella</td>
<td>1.3</td>
<td>1.1</td>
<td>0.9</td>
<td>1.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>9.4</td>
<td>9.9</td>
<td>8.5</td>
<td>5.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>10.0</td>
<td>7.4</td>
<td>4.7</td>
<td>6.3</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.2</td>
<td>2.5</td>
<td>1.8</td>
<td>2.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>32.4</td>
<td>24.4</td>
<td>20.4</td>
<td>20.8</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Legs 1243. Femur 12.50 times length of cephalothorax. Legs covered with long setae (specially legs I and II). Metatarsus I trichobothrium 0.86. Pedipalp as in Figures 345–347, 361–365.

**Female** (holotype): Total length 7.4. Cephalothorax 3.6 long, 2.8 wide, 1.9 high; light brown with a dark brown longitudinal line and margins (Figure 356). Sternum 2.0 long, 1.6 wide; dark brown. Abdomen 3.7 long, 3.1 wide, 3.5 high; light brown with a dark brown pattern (Figure 356). AME diameter 0.22. PME 0.90, PLE 0.90, ALE 0.90 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.77 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 0.50 times one ALE diameter. Clypeus height 2.00 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files absent. Legs light brown with dark brown annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>6.1</td>
<td>5.3</td>
<td>4.0</td>
<td>4.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Patella</td>
<td>1.4</td>
<td>1.3</td>
<td>1.0</td>
<td>1.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>6.5</td>
<td>5.3</td>
<td>3.4</td>
<td>5.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>6.1</td>
<td>5.1</td>
<td>3.6</td>
<td>4.8</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.7</td>
<td>2.3</td>
<td>1.7</td>
<td>2.1</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>22.8</td>
<td>19.3</td>
<td>13.7</td>
<td>17.9</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.69 times length of cephalothorax. Legs
covered with long setae. Metatarsus I trichobothrium 0.87. Epigynum as in Figures 349–353, 357–360, 367.

VARIATION.—Male cephalothorax ranges in length from 2.7 to 3.8, female from 3.3 to 5.1. Some females have very inconspicuous (scale-like) stridulatory striae. Some individuals have a very dark body coloration, with the abdominal light
FIGURES 361–367.—*Pimno brevia* Chamberlin and Ivie, male from California, female from Oregon: 361, palp, ventral; 362, palp ectal; 363, conductor; 364, cymbial denticulated process and PCS; 365, cymbial denticulated process; 366, base of palpal femur (mesal) with enlarged setal bases; 367, epigynum, dorsal (dorsal plate projections are broken off).
pattern quite reduced (Figure 354). The dorsal plate projections vary in size and in the distance between them (approximately no longer than one projection length; Figures 349, 352, 353).

ADDITIONAL MATERIAL EXAMINED.—UNITED STATES: CALIFORNIA: Del Norte Co.: near Crescent City, Six River Natl. For., 4 Jul 1951 (Levi, MCZ), 1♀; Del Norte Coast, Redwood State Park, off US 101 (41°38′N, 124°05′W), 17 Jul 1990, *Sequoia sempervirens* forest (G. Hormiga, USNM), 1♀; Middle Fork of Smith river (41°51′N, 123°55′W), 4 Sep 1963 (J. and W. Ivie, AMNH), 1♂; Patrick (41°50′N, 123°50′W), 16 Sep 1961 (W.J. Gertsch, W. Ivie, AMNH), 1♀; Humboldt Co.: Arcata, Azalea Park, 3 Sep 1963 (J. and W. Ivie, AMNH), 1♂, 2♀; 1.5 mi (2.4 km) E Bridgeville, off Rt. 36 (40°27′N, 123°46′W), 18 Jul 1990 (G. Hormiga, USNM), 1♀; 1–1.5 mi (1.6–2.4 km) E Bridgeville, off Rt. 36 (40°27′N, 123°46′W), 18 Jul 1990 (G. Hormiga, USNM), 1♂, 1♀; Carlotta (40°N, 124°W), 15 Sep 1965 (W.J. Gertsch, W. Ivie, AMNH), 1♂; Carlotta (40°N, 124°W), 15 Sep 1965 (W.J. Gertsch, W. Ivie, AMNH), 1♀; Grizzly Creek Redwoods State Park, Hiker’s trail (40°31′N, 124°58′W), 18 Jul 1990, patch of forest in urban area (T.W. Davies, CAS), 1♀; near Miranda, Humboldt Redwoods State Park, 7.2 mi (11.7 km) E of Carlotta (40°32′N, 123°56′W), 1 Oct 1959 (V. Roth, AMNH), 1♀; Mckinleyville bog area, near Azalea a Avenue, 5 Aug 1980 (T.W. Davies, CAS), 1♀; near Miranda, Humboldt Redwoods St. Park (40°14′N, 123°58′W), 30 Sep 1963 (W.J. Gertsch, AMNH), 1♂; 5 mi (8 km) S of Orleans (41°16′N, 123°35′W), 22 Aug 1959 (W.J. Gertsch, V. Roth, AMNH), 1♂; 5 mi (8 km) S of Scotia (40°26′N, 124°03′W), 14 Sep 1961 (W.J. Gertsch, W. Ivie, AMNH), 1♂, 1♀; Mendocino Co.: 8 mi (13 km) N Branscomb, NCCRP, 18–21 May 1985 (E. Schlinger, MCZ), 8 mi (13 km) N Branscomb, NCCRP, 18–21 May 1985 (E. Schlinger, USNM), 1♂(reared to adult, 15 Jul 1985); Rt. 208, 15 mi (24 km) S of Leggett, 24 Mar 1980, *Abies* forest (J.A. Coddington, MCZ), 3♀; Rt. 208, 15 mi (24 km) S of Leggett, 24 Mar 1980, *Abies* forest (J.A. Coddington, USNM), 1♀; off Rt. 1, between Leggett and Rockport (39°46′N, 126°47′W), 19 Jul 1990 (G. Hormiga, USNM), 2♂; Piercy (39°58′N, 123°47′W), 23 Sep 1949 (V. Roth, AMNH), 1♀.

OREGON: Coos Co.: near Bridge Camp Myrtlewood, 28–31 Jul 1954 (V. Roth, AMNH), 1♀; Coos Bay, Thomas Street (42°23′N, 124°11′W), 15 Jul 1990, patch of forest in urban area (G. Hormiga, USNM), 1♂; Curry Co.: Azalea State Park, Brookings (42°04′N, 124°15′W), 16 Jul 1990 (G. Hormiga and L. Garcia de Mendoza, USNM), 1♂, 2♀; Brookings, 6 Jun 1951 (B. Malkin, AMNH), 1♂, 7 mi (11.2 km) E Brookings, Myrtle Grove, Chetco river, 29 May 1952 (V. Roth, AMNH), 1♀; 10 mi (16 km) N Brookings, 1 May 1951 (V. Roth, AMNH), 1♀; 12 mi (19.2 km) NE of Gold Beach (42°30′N, 124°15′W), 30 Sep 1959 (V. Roth, AMNH), 5♂, 24♀; Pistol river, 18 Jun 1952 (B. Malkin, AMNH), 1♀; Pistol river, 17 Sep 1950 (B. Malkin, AMNH), 1♀; Port Orford, 17 Jul 1951 (B. Malkin, AMNH), 1♀; Jackson Co.: Ashland, 30 Aug 1931 (W. Ivie, AMNH), 1♀; Klamath Co.: Klamath L., 12 Sep 1932 (T. Kincaid, UW), 1♂; Lane Co.: Blue Pool Forest Camp, Willamette Ntl. For., 7 Sep 1949 (V. Roth, AMNH), 1♀.

**Pimoa curvata** Chamberlin and Ivie


**Diagnosis.**—Male cymbium with a large retrolateral projection which bears on its distal margin several rows of small teeth (Figures 368–370, 384, 385, 387). The cymbial dentilicated process lays between the other retrolateral projection and the distal end of the PCS. PEP with a wide lamelliform base. Conductor very large and bilobate (Figures 368, 388). Epigynum with a thick and rounded dorsal plate projection (Figure 375).

**Male** (from Lake Wenatchee, Washington): Total length 7.2. Cephalothorax 3.4 long, 2.7 wide, 2.1 high; light brown, darker at the margins. Sternum 2.0 long, 1.6 wide; dark brown. Abdomen 3.4 long, 2.9 wide, 3.9 high; dark gray-brown pattern on a whitish background (Figure 372). AME diameter 0.16. PME 0.88, PLE 0.88, ALE 1.00 times one AME diameter. AME separation 0.63 times their diameter, PME separation 1.14 times their diameter. PME-PEL separation 1.00 times one PME diameter, AME-ALK separation 0.75 times one ALE diameter. Clypeus height 3.00 times one AME diameter. Clypeus bilobate with three prolateral and two retrolateral teeth. Clypeal stridulating files present and conspicuous. Legs yellowish brown with darker brown annuli. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>5.7</td>
<td>4.8</td>
<td>3.8</td>
<td>4.7</td>
<td>1.5</td>
</tr>
<tr>
<td>Patella</td>
<td>1.1</td>
<td>1.0</td>
<td>0.8</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Tibia</td>
<td>6.0</td>
<td>5.2</td>
<td>3.4</td>
<td>4.8</td>
<td>0.5</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>5.8</td>
<td>4.8</td>
<td>2.6</td>
<td>4.8</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.5</td>
<td>2.1</td>
<td>1.6</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Total</td>
<td>21.1</td>
<td>17.9</td>
<td>12.2</td>
<td>17.2</td>
<td>3.64</td>
</tr>
</tbody>
</table>

**Legs** 1243. Femur I 1.68 times length of cephalothorax. Metatarsus I trichobothrium 0.90. Pedipalp as in Figures 368–371, 373, 374, 384–389.

**Female** (Holotype): Total length 7.3. Cephalothorax 3.6 long, 2.7 wide, 1.9 high; reddish brown darker at the margins. Sternum 2.1 long, 1.6 wide; dark brown, darker at the margins. Abdomen 3.8 long, 3.2 high; dark gray-brown pattern on a whitish background, very similar to the male. AME diameter 0.20. PME 1.00, PLE 0.90, ALE 0.90 times one AME diameter. AME separation 0.60 times their diameter, PME separation 0.77 times their diameter. PME-PEL separation 0.77 times one
FIGURES 368–374.—Pimoa curvata Chamberlin and Ivie, male from Washington: 368, palp, ventral; 369, same, dorsal; 370, same, ectal; 371, same, mesal; 372, abdomen, dorsal; 373, tegulum, schematic, ventral; 374, same, dorsomesal. (Scale lines: 0.5 mm, except 372, 1.0 mm.)
FIGURES 375–383.—*Pinoa curvata* Chamberlin and Ivie, female: 375, female from Washington, epigynum, ventral; 376, same, posterior; 377, same, lateral; 378, female from Washington, epigynum, cleared, dorsal; 379, same, ventral; 380, same, lateral; 381, epigynum, lateral; 382, same, dorsal; 383, holotype, cephalothorax, dorsal.

(Scale lines: 0.5 mm, except 383, 1.0 mm.)

PME diameter, AME-ALE separation 0.55 times one ALE diameter. Clypeus height 2.20 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files absent. Legs brown with dark gray annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>5.0</td>
<td>4.6</td>
<td>3.7</td>
<td>4.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Patella</td>
<td>1.2</td>
<td>1.1</td>
<td>1.0</td>
<td>1.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Tibia</td>
<td>5.2</td>
<td>4.6</td>
<td>3.0</td>
<td>4.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>4.6</td>
<td>4.1</td>
<td>3.2</td>
<td>4.3</td>
<td>-</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.3</td>
<td>1.9</td>
<td>1.4</td>
<td>1.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Total</td>
<td>18.3</td>
<td>16.3</td>
<td>12.3</td>
<td>16.4</td>
<td>4.1</td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.39 times length of cephalothorax.

Metatarsus I trichobothrium 0.87. Epigynum as in Figures 375–382.

VARIATION.—Male cephalothorax ranges in length from 3.2 to 3.4, female from 3.1 to 4.5. Some specimens have legs covered with long setae. Some specimens have darker abdomens, with a reduced light pattern.

ADDITIONAL MATERIAL EXAMINED.—UNITED STATES: OREGON: Hood River Co.: Parkdale, 31 Mar 1938 (Gray and Schuh, AMNH), 1♀; WASHINGTON: Chelan Co.: Bridge Cr. Camp (47.563°N, 120.782°W), 8–9 May 1987, 2280 ft, ex rotten logs and stumps (R. Crawford, UW), 1♀; Lake Wenatchee (47.80–84°N, 120.7°W), 27 Sep 1970, 1900 ft (J.R. Thompson, UW), 1♂; Orr Creek (47.306°N, 120.340°W), 4 May 1974, 3380 ft, under log bark (R. Crawford, UW), 1♀; W
FIGURES 384-389.—Pimou curvata Chamberlin and Ivie, male from Washington: 384, palp, ventral; 385, cymbial denticulated process, cymbial apophysis, and PCS; 386, paracymbium, ectal; 387, cymbial denticulated process and cymbial apophysis; 388, palp, apical closeup; 389, cymbial apophysis, closeup.

Tronsen Mdws. (47.336°N, 120.569°W), 7 Jul 1985, under bark by lower mdws (R. Crawford, UW), 1♂ (reared, matured Sep 1985); Kittitas Co.: (47.117°N, 120.785°W), 26 May 1986, 2160 ft, in old shack in Populus woods (R. Crawford, UW #7107), 1♂; Lost Lake Trailhead (47.022°N, 120.942°W), 5 Jun 1977, 4480 ft, under log bark (R. Crawford, UW), 1♂; Morrison Canyon (47.119°N, 120.811°W), 25 May 1986, 2450 ft (R. Crawford, UW), 1♀; Klickitat Co.: State Hwy 141, near Husum (45.786°N, 121.496°W), 11 Apr 1986, 550 ft, under rocks and logs (R. Crawford, UW), 1♀; Okanogan Co.:
FIGURES 390–394.—*Pimoa laurae*, new species, male from California: 390, palp, mesal; 391, same, ectal; 392, same, ventral; 393, same, dorsal; 394, holotype, abdomen, dorsal. (Scale lines: 0.5 mm, except 394, 0.25 mm.)
FIGURES 395–402.—*Pimoa laurae*, new species, female from California: 395, epigynum, ventral; 396, same, dorsal; 397, same, lateral; 398, copulatory opening, schematic, lateroventral; 399, epigynum, cleared, ventral; 400, same, dorsal; 401, same, lateral; 402, paratype, abdomen, dorsal. (Scale lines: 0.5 mm.)

**Tiffany Spr. Camp (48.699°N, 119.955°W), 31 Jul 1985, 6700 ft, under rocks and wood on ground (R. Crawford, UW), 4♀; Skamania Co.: S Peterson Prairies (45.964°N, 121.654°W), 19 Jun 1975, 2900 ft, near abandoned outhouse, with eggs, one prey of *Novalena* (R. Crawford, UW), 1♂; S Peterson Prairies (45.964°N, 121.654°W), 15 Jun 1975, 2900 ft, under rocks and logs (R. Crawford, UW), 1♂; Yakima Co.: N Fork Oak Cr. (46.736°N, 120.922°W), 4 Jun 1988, 2820 ft, under log bark (R. Crawford, UW), 1♀; Rimrock Lake, SE Rainier Park, 12 Sep 1965 (W. Ivie, AMNH), 1♂, 1♀.**

**DISTRIBUTION.**—Central Washington and northern Oregon (Figure 189).

*Pimoa laurae*, new species

**FIGURES 2, 390–408, 117**

**TYPES.**—Male holotype, four males and two female paratypes from Bear Creek, near intersection Route 89 and Alpine Meadow Road, 4 mi (6.4 km) NW of Tahoe City, Placer Co., California (39°12'N, 120°15'W), 28 VII 1990, G. Hormiga and W.P. Maddison cols. Males collected as subadults and reared in the laboratory, molted to adults in August 1990. Deposited in USNM.

**ETYMOLOGY.**—The species epithet is a patronym after my wife Laura.

**DIAGNOSIS.**—Males can be distinguished from its sister species *edenticulata* by the shape of the PCS and the pointed sclerotized end of the cymbial denticulate projection (Figures 391, 392). Females differ from those of *edenticulata* in having the dorsal plate projections curved ventrally (Figure 397).

**Male** (holotype): Total length 7.3. Cephalothorax 3.4 long, 2.5 wide, 1.9 high; light brown, darker at margins and with a gray longitudinal line. Sternum 1.9 long, 1.6 wide; dark brown, darker at margin. Abdomen 3.5 long, 2.5 wide, 1.9 high; whitish with dark gray pattern. AME diameter 0.50. PME 0.80, PLE 0.80, ALE 0.80 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.75 times their diameter. PME-PLE separation 0.89 times one PME diameter, AME-ALE separation 0.75 times one ALE diameter. Clypeus height 2.00 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present. Legs brown with dark gray annuli, less pronounced in the first femur. Leg and pedipalp lengths of male described above:
**Figures 403-408.** *Pimoa laurae*, new species, male from California: 403, palp, ventral; 404, palp, ectal; 405, conductor and PEP apex; 406, conductor; 407, cymbial denticulated process; 408, cymbial denticulated process and PCS.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>6.5</td>
<td>5.6</td>
<td>4.1</td>
<td>5.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.3</td>
<td>1.2</td>
<td>1.0</td>
<td>1.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Tibia</td>
<td>6.7</td>
<td>5.7</td>
<td>4.9</td>
<td>3.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>7.4</td>
<td>6.3</td>
<td>5.4</td>
<td>4.3</td>
<td>–</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.9</td>
<td>2.5</td>
<td>2.1</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>Total</td>
<td>24.8</td>
<td>21.3</td>
<td>17.5</td>
<td>15.9</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Legs 1234. Femur I 1.91 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.91. Pedipalp as in Figures 390-393, 403-408.

**Female** (paratype): Total length 7.3. Cephalothorax 3.3 long, 2.5 wide, 1.8 high; brown, darker at margins and with a gray longitudinal line. Sternum 2.1 long, 3.4 wide; dark brown. Abdomen 5.0 long, 3.3 wide, 3.4 high; whitish with dark brown pattern. AME diameter 0.20. PME 0.90, PLE 0.90, ALE 0.90.
times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.78 times their diameter. PME-PLE separation 0.89 times one PME diameter. AME-ALE separation 0.50 times one AME diameter. Clypeus height 1.60 times one AME diameter. Clypeal stridulating files present but inconspicuous. Legs light brown with dark brown annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>5.5</td>
<td>4.7</td>
<td>3.8</td>
<td>4.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Patella</td>
<td>1.2</td>
<td>1.2</td>
<td>1.0</td>
<td>1.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Tibia</td>
<td>5.7</td>
<td>4.7</td>
<td>3.1</td>
<td>4.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>5.3</td>
<td>4.7</td>
<td>3.5</td>
<td>4.5</td>
<td>0.7</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.5</td>
<td>2.1</td>
<td>1.5</td>
<td>1.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>20.2</td>
<td>17.4</td>
<td>12.9</td>
<td>17.1</td>
<td>3.5</td>
</tr>
</tbody>
</table>

Legs 1243. Femur 1.167 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.84. Epigynum as in Figures 395–401.

VARIATION.—Male cephalothorax ranges in length from 3.4 to 4.2, female from 3.3 to 5.8.

ADDITIONAL MATERIAL EXAMINED.—UNITED STATES: CALIFORNIA: Placer Co.: 3 mi (4.8 km) N of Tahoe City (39°13'N, 120°09'W), 20 Sep 1961 (W.J. Gertsch, V.D. Roth, AMNH), 1♀. Yuba Co.: Camptonville (39°N, 121°W), 7 Sep 1959 (W.J. Gertsch, V.D. Roth, AMNH), 1♀.

DISTRIBUTION.—Known only from eastern California (Figure 117).

**Pimoa edenticulata**, new species

*Figures 1, 409–430, 117*

TYPES.—Male holotype, two males and three females paratypes from Campground 3 mi (4.8 km) W of Willow Creek, Six Rivers National Forest, Humboldt Co., California; oak-bay-madrone forest, ex webs in evening, 27 Oct 1990, D. Ubick col. Holotype deposited in CAS, paratypes deposited in DU.

ETYMOLOGY.—The species epithet is from the Latin *edenticula* (without small teeth). It refers to the loss in this species of the characteristic denticles or cuspules of the cymbial projection of pimoids.

DIAGNOSIS.—Males can be distinguished from its sister species *laureae* by the shape of the PCS. The absence of the characteristic pimoid denticles of the cymbial process is also diagnostic (Figures 410, 424). Females differ from those of *laureae* in having the epigynal dorsal plate projections straight instead of curved (Figures 415, 419).

**Male** (holotype): Total length 8.2. Cephalothorax 3.7 long, 2.8 wide, 2.2 high; light brown, with dark gray margin and longitudinal line. Sternum 2.2 long, 1.8 wide; dark brown with dark gray margin. abdomen 4.0 long, 2.7 wide, 2.3 high; light brown with a dark gray pattern. AME diameter 0.24, PME 0.75, PLE 0.75, ALE 0.75 times one AME diameter. AME separation 0.50 times their diameter, PME separation 0.67 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 1.11 times one ALE diameter. Clypeus height 2.00 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present and scale-like. Legs light brown with dark gray annuli. Leg and pedipalp lengths of male described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>7.7</td>
<td>6.1</td>
<td>4.1</td>
<td>5.8</td>
<td>2.1</td>
</tr>
<tr>
<td>Patella</td>
<td>1.4</td>
<td>0.8</td>
<td>1.0</td>
<td>1.1</td>
<td>0.7</td>
</tr>
<tr>
<td>Tibia</td>
<td>9.3</td>
<td>6.6</td>
<td>3.9</td>
<td>5.9</td>
<td>0.8</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>9.4</td>
<td>6.7</td>
<td>4.6</td>
<td>6.0</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.5</td>
<td>2.7</td>
<td>1.9</td>
<td>2.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>31.3</td>
<td>22.9</td>
<td>15.5</td>
<td>21.0</td>
<td>4.9</td>
</tr>
</tbody>
</table>

Legs 1243. Femur 1.08 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.88. Pedipalp as in Figures 409–412, 421–426.

**Female** (paratype): Total length 9.0. Cephalothorax 4.2 long, 3.1 wide, 2.2 high; light brown, with very dark gray margin and longitudinal line. Sternum 2.4 long, 1.9 wide; dark brown, darker at margins. Abdomen 4.7 long, 3.5 wide, 5.6 high; light brown with dark gray pattern. AME diameter 0.24, PME 0.75, PLE 0.75, ALE 0.75 times one AME diameter. AME separation 0.58 times their diameter, PME separation 1.28 times their diameter. PME-PLE separation 1.00 times one PME diameter, AME-ALE separation 0.56 times one ALE diameter. Clypeus height 1.91 times one AME diameter. Chelicerae with three prolateral and two retrolateral teeth. Cheliceral stridulating files present and scale-like. Legs light brown with very dark brown annuli. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>6.1</td>
<td>5.2</td>
<td>4.1</td>
<td>5.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Patella</td>
<td>1.5</td>
<td>1.4</td>
<td>1.1</td>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Tibia</td>
<td>6.8</td>
<td>5.4</td>
<td>3.4</td>
<td>5.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>6.0</td>
<td>2.1</td>
<td>3.7</td>
<td>4.8</td>
<td>—</td>
</tr>
<tr>
<td>Tarsus</td>
<td>2.7</td>
<td>2.2</td>
<td>1.6</td>
<td>1.9</td>
<td>1.4</td>
</tr>
<tr>
<td>Total</td>
<td>23.1</td>
<td>16.3</td>
<td>13.9</td>
<td>18.5</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Legs 1432. Femur 1.45 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.82. Epigynum as in Figures 414–419.

VARIATION.—Male cephalothorax ranges in length from 3.2 to 3.7, female from 2.8 to 4.2.

ADDITIONAL MATERIAL EXAMINED.—UNITED STATES: CALIFORNIA: Humboldt Co.: 10 mi (16 km) E of Bridgeville (40°N, 123°W), 20 Aug 1959 (W.J. Gertsch and V.D. Roth, AMNH), 1♀. Mendocino Co.: 8 mi (12.8 km) N of Branscomb, 18–21 May 1985 (E. Schlinger, USNM), 1♀; Standish-Hickley State Park, 20 Sep 1990, webs at campsite structures (D. Ubick, DU), 1♂ (matured 24 Sep 1990), 1♀. Trinity Co.: Del Loma, 25 Jun 1953 (W.J. and J.W. Gertsch, AMNH), 1♀; 5 mi (8 km) E of Forest Glen, 21 Aug 1959 (W.J. Gertsch and V.D. Roth,
FIGURES 409–413.—*Pimoa edenticulata*, new species, male from California: 409, palp, mesal; 410, same, ventral; 411, same, ectal; 412, same, dorsal; 413, holotype, dorsal. (Scale lines: 0.5 mm, except 413, 1.0 mm.)
FIGURES 414–420.—Pimou edenticulata, new species, female from California: 414, epigynum, ventral; 415, same, lateral; 416, epigynum, cleared, ventral; 417, same, dorsal; 418, epigynum, ventral; 419, same, lateral, 420, paratype, dorsal. (Scale lines: 0.5 mm.)

AMNH), 1♀; E of Weaverville (40°45'N, 122°50'W), 6 Apr 1960 (W.J. Gertsch and W. Ivie, AMNH), 2♀; 13 mi (23.8 km) N of Weaverville, near Tanbark picnic ground, off Route 3, Sahasta-Trinity National Forest (40°52'N, 122°53'W), 30 Jul 1990 (G. Hormiga, USNM), 3♂ (molted 27, 28, 29 Aug 1990), 3♀.

DISTRIBUTION.—Northern California (Figure 117).
FIGURES 421–426.—Pimoe edenticulata, new species, male from California: 421, palp, ventral; 422, pedipalpal tibia trichobothrium; 423, embolus; 424, apical end of cymbial denticulated process; 425, conductor; 426, PCS.
Pimoa mephitis, new species

FIGURES 431–439. B

TYPES.—Female holotype and paratype from Skunk Hollow Cave (Sec. 23, T14N R12W), 15 mi (24 km) W of Fort Jones, Siskiyou Co., California; 29 Apr 1979, D.C. Rudolph, D. Cowan, and B. van Ingen col. Deposited in AMNH.

ETYMOLOGY.—Named after the mustelid genus Mephitis.

DIAGNOSIS.—The pointed distal end of the epigynum (Figures 431–433) is diagnostic for this species.

Male: Unknown.
Female (holotype): Total length 10.4. Cephalothorax 5.5 long, 3.6 wide, 1.9 high; brown. Sternum 2.8 long, 2.2 wide; reddish brown. Abdomen 7.0 long, 4.4 wide, 3.7 high; whitish with a dark gray pattern. AME diameter 0.22. PME 1.00, PLE 1.00, ALE 0.91 times one AME diameter. AME separation 0.45 times their diameter, PME separation 0.82 times their diameter. PME-PLE separation 1.09 times one PME diameter, AME-ALE separation 0.91 times one ALE diameter. Clypeus height 2.54 times one AME diameter. Chelicerae with three prolateral
and two retrolateral teeth. Cheliceral stridulating files absent. Legs reddish brown. Leg and pedipalp lengths of female described above:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Pdp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur</td>
<td>10.9</td>
<td>9.5</td>
<td>7.5</td>
<td>9.5</td>
<td>2.1</td>
</tr>
<tr>
<td>Patella</td>
<td>1.8</td>
<td>1.8</td>
<td>1.3</td>
<td>1.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Tibia</td>
<td>11.9</td>
<td>10.2</td>
<td>6.7</td>
<td>1.6</td>
<td>1.5</td>
</tr>
<tr>
<td>Metatarsus</td>
<td>11.9</td>
<td>10.2</td>
<td>7.4</td>
<td>1.6</td>
<td>2.4</td>
</tr>
<tr>
<td>Tarsus</td>
<td>3.7</td>
<td>3.2</td>
<td>2.2</td>
<td>2.2</td>
<td>6.7</td>
</tr>
<tr>
<td>Total</td>
<td>40.2</td>
<td>34.9</td>
<td>22.1</td>
<td>22.1</td>
<td></td>
</tr>
</tbody>
</table>

Legs 1243. Femur I 1.98 times length of cephalothorax. Legs covered with long setae. Metatarsus I trichobothrium 0.85. Epigynum as in Figures 431-435.

FIGURES 431-436.—*Pimela mephitis*, new species, female from California: 431, epigynum, lateral; 432, same, dorsal; 433, same, ventral; 434, epigynum, cleared, ventral; 435, same, dorsal; 436, abdomen, dorsal. (Scale lines: 0.5 mm, except 436, 1.0 mm.)

VARIATION.—Female cephalothorax ranges in length from 4.6 to 5.6.

ADDITIONAL MATERIAL EXAMINED.—UNITED STATES: CALIFORNIA: Siskiyou Co.: Marble Mountain Wilderness Area, Bigfoot Cave, breathing entrance, 6 Jul 1985 (T.S. Briggs, DU), 1♀; Mountain Wilderness Area, Trail Junction Cave, 29 Apr 1979 (D.C. Reed, C. Cowan, and B. van Ingen, AMNH), 1♀; Marble Mountain Wilderness Area, Marble Valley, Klamath National Forest, 1 Aug 1975, in cave (D. Hemphill, AMNH), 1♀; Marble Mountain Wilderness Area, Marble Valley, Klamath National Forest, 7 Nov 1979, 7000 ft (D. Hemphill, AMNH), 1♀.

DISTRIBUTION.—Known only from the Marble Mountains in northern California (Figure 117).
Figures 437-439.—*Pimoa mephitis*, new species, spinnerets, female from California: 437, ALS; 438, PMS; 439, PLS.

Figure 440.—Strict consensus cladogram for the Pimoidae and outgroups. The cladogram length is 135 steps, and the consistency and retention indices are 0.62 and 0.80, respectively. Nodes one to five refer to the pimoid clades in Figure 441 and are discussed in the text.
OUTGROUPS

LINYPHIIDAE
Stemonyphantes
PIMOIDAE (1, 2, or 3)

OUTGROUPS

LINYPHIIDAE
Stemonyphantes
PIMOIDAE (1 or 2)

breviata group
hespera group
rupicola
altioculata group
gandhii group
cthulhu group
breuili

FIGURE 441 (A–C).—Summary of the alternative topologies for the pimoids and outgroups. Figures 441A and B show the alternative placements of *Stemonyphantes*; numbers 1, 2, and 3 refer to alternative resolutions for the Pimoidae. Figure 441C show the cladistic network for the pimoid taxa (pimoid groups refer to the clades defined in Figure 440). Three possible rooting options exist for the network of pimoids, represented by black bars (labeled 1, 2, and 3).
FIGURE 442.—Preferred cladogram for the Pimoidae and outgroups with character changes mapped on it (the mapping of several transformations is ambiguous, see text). The cladogram length is 118 steps, and the consistency and retention indices are 0.71 and 0.87, respectively.


Metella breuili Fage (Araneidae) accom-
Maurer, R., and K. Thaler
Millidge, A.F.
Peters, H.M., and J. Kovoor
Petrunkevitch, A.
Platnick, N.I.
Platnick, N.I., J.A. Coddington, R.R. Forster, and C.E. Griswold
Platnick, N.I., C.E. Griswold, and J.A. Coddington
Ribera, C.
Roewer, C.F.
Roth, V.D.
Roth, V.D., and B.M. Roth
Simon, E.
Tanasevitch, A.V.
Thaler, K.
van Helsdingen, P.J.
Wunderlich, J.
Manuscripts intended for series publication receive substantive review (conducted by their originating Smithsonian museums or offices) and are submitted to the Smithsonian Institution Press with Form SI-36, which must show the approval of the appropriate authority designated by the sponsoring organizational unit. Requests for special treatment—use of color, foldouts, case-bound covers, etc.—require, on the same form, the added approval of the sponsoring authority.

Review of manuscripts and art by the Press for requirements of series format and style, completeness and clarity of copy, and arrangement of all material, as outlined below, will govern, within the judgment of the Press, acceptance or rejection of manuscripts and art.

Copy must be prepared on typewriter or word processor, double-spaced, on one side of standard white bond paper (not erasable), with 1 1/4" margins, submitted as ribbon copy (not carbon or xerox), in loose sheets (not stapled or bound), and accompanied by original art. Minimum acceptable length is 30 pages.

Front matter (preceding the text) should include: title page with only title and author and no other information; abstract page with author, title, series, etc., following the established format; table of contents with indents reflecting the hierarchy of heads in the paper; also, foreword and/or preface, if appropriate.

First page of text should carry the title and author at the top of the page; second page should have only the author’s name and professional mailing address, to be used as an unnumbered footnote on the first page of printed text.

Center heads of whatever level should be typed with initial caps of major words, with extra space above and below the head, but no other preparation (such as all caps or underline, except for the underline necessary for generic and specific epithets). Run-in paragraph heads should use period/dashes or colons as necessary.

Tabulations within text (lists of data, often in parallel columns) can be typed on the text page where they occur, but they should not contain rules or numbered table captions.

Formal tables (numbered, with captions, boxheads, stubs, rules) should be submitted as carefully typed, double-spaced copy separate from the text; they will be typeset unless otherwise requested. If camera-copy use is anticipated, do not draw rules on manuscript copy.

Taxonomic keys in natural history papers should use the aligned-couplet form for zoology and may use the multi-level indent form for botany. If cross referencing is required between key and text, do not include page references within the key, but number the keyed-out taxa, using the same numbers with their corresponding heads in the text.

Synonymy in zoology must use the short form (taxon, author, year:page), with full reference at the end of the paper under “Literature Cited.” For botany, the long form (taxon, author, abbreviated journal or book title, volume, page, year, with no reference in “Literature Cited”) is optional.

Text-reference system (author, year:page used within the text, with full citation in “Literature Cited” at the end of the text) must be used in place of bibliographic footnotes in all Contributions Series and is strongly recommended in the Studies Series: “(Jones, 1910:122)” or “...Jones (1910:122).” If bibliographic footnotes are required, use the short form (author, brief title, page) with the full citation in the bibliography.

Footnotes, when few in number, whether annotative or bibliographic, should be typed on separate sheets and inserted immediately after the text pages on which the references occur. Extensive notes must be gathered together and placed at the end of the text in a notes section.

Bibliography, depending upon use, is termed “Literature Cited,” “References,” or “Bibliography.” Spell out titles of books, articles, journals, and monographic series. For book and article titles use sentence-style capitalization according to the rules of the language employed (exception: capitalize all major words in English). For journal and series titles, capitalize the initial word and all subsequent words except articles, conjunctions, and prepositions. Transliterate languages that use a non-Roman alphabet according to the Library of Congress system. Underline (for italics) titles of journals and series and titles of books that are not part of a series. Use the parentheses/colon system for volume (number):pagination: “(10:2):5-9.” For alignment and arrangement of elements, follow the format of recent publications in the series for which the manuscript is intended. Guidelines for preparing bibliography may be secured from Series Section, SI Press.

Legends for illustrations must be submitted at the end of the manuscript, with as many legends typed, double-spaced, to a page as convenient.

Illustrations must be submitted as original art (not copies) accompanying, but separate from, the manuscript. Guidelines for preparing art may be secured from the Series Section, SI Press. All types of illustrations (photographs, line drawings, maps, etc.) may be intermixed throughout the printed text. They should be termed Figures and should be numbered consecutively as they will appear in the monograph. If several illustrations are treated as components of a single composite figure, they should be designated by lowercase italic letters on the illustration; also, in the legend and in text references the italic letters (underlined in copy) should be used: “Figure 9b.” Illustrations that are intended to follow the printed text may be termed Plates, and any components should be similarly lettered and referenced: “Plate 9b.” Keys to any symbols within an illustration should appear on the art rather than in the legend.

Some points of style: Do not use periods after such abbreviations as “mm, ft, USNM, NNE.” Spell out numbers “one” through “nine” in expository text, but use digits in all other cases if possible. Use of the metric system of measurement is preferable; where use of the English system is unavoidable, supply metric equivalents in parentheses. Use the decimal system for precise measurements and relationships, common fractions for approximations. Use day/month/year sequence for dates: “9 April 1976.” For months in tabular listings or data sections, use three-letter abbreviations with no periods: “Jan, Mar, Jun,” etc. Omit space between initials of a personal name: “J.B. Jones.”

Arrange and paginate sequentially every sheet of manuscript in the following order: (1) title page, (2) abstract, (3) contents, (4) foreword and/or preface, (5) text, (6) appendices, (7) notes section, (8) glossary, (9) bibliography, (10) legends, (11) tables. Index copy may be submitted at page proof stage, but plans for an index should be indicated when the manuscript is submitted.