A REVISION OF THE GENUS
OLIARUR IN NORTH AMERICA,
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F. W. Mead, 1968

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North Carolina State University at Raleigh,
Ph.D., 1968
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A REVISION OF THE GENUS OLIARUS IN NORTH AMERICA, NORTH OF MEXICO (HOMOPTERA: CIXIIDAE)

by

FRANK WALDRETH MEAD

A thesis submitted to the Graduate Faculty of
North Carolina State University at Raleigh
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

DEPARTMENT OF ENTOMOLOGY

RALEIGH

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APPROVED BY:

Robert L. Rabb | Maurice H. Farrier

James W. Hardin | David A. Young
Chairman of Advisory Committee

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BIOGRAPHY

The author, Frank Waldreth Mead, was born June 11, 1922, at Columbus, Ohio. He attended local public schools, graduating from North High School in June 1940. He attended the Ohio State University from 1940 to 1943, majored in Wildlife Conservation the first two years, then changed to Applied Entomology. His education was interrupted by service in the United States Army Medical Department from 1943 to 1946; he was discharged with the rank of Technician 4th Class.

His education was resumed at the Ohio State University in 1946, leading to a Bachelor of Science degree in entomology in 1947 and a Master of Science degree in entomology in 1949. From 1950 to 1953, he was a biological aide with the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, Division of Forest Insects, Columbus, Ohio. He has served as an entomologist from 1953-1958 and 1960 to the present with the organization currently known as the Division of Plant Industry, Florida Department of Agriculture, Gainesville, Florida. He attended North Carolina State University at Raleigh from 1958 to 1960, majoring in entomology and minoring in botany.

The author married Miss Eileen Cornwell in 1945 and is the father of two sons.

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Museum (Natural History) was very helpful in comparing some specimens with type material in that museum. Dr. R. G. Fennah, Commonwealth Institute of Entomology, London, England, suggested the appropriate nomenclature for veins of the forewings (tegmina) and posterior wings (through a request from Dr. J. P. Kramer).

The late Mr. Erdman West, University of Florida, kindly identified plants the author brought to him from Oliarus habitats.

To his children and his wife, the author expresses his sincere gratitude for their sacrifices and forebearance. The author's parents, Mr. and Mrs. A. A. Mead, Columbus, Ohio, have always encouraged academic pursuits and have been most unselfish in giving financial assistance.

To Dr. David A. Young, Jr., the author extends his most sincere and humble appreciation for the encouragement and assistance so generously provided.

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INTRODUCTION

This taxonomic treatment assembles in one paper all the described taxa of the genus Oliarus (Homoptera:Fulgoroidea:Cixiidae) from North America, north of Mexico: (1) to provide descriptions and illustrations of each species as interpreted from the habitus and terminalia of male specimens, (2) to note variation within species, (3) to record habitats, food plants, geographic and seasonal distribution, and other biological data, and (4) to construct a key whereby the males may be identified to species.

The present problem was undertaken at the joint suggestion of Dr. James P. Kramer, Systematic Entomology Laboratory, Entomology Research Division, Agricultural Research Service, United States Department of Agriculture, Washington, D. C., and Professor David A. Young, Jr., Department of Entomology, North Carolina State University. The need for a revision becomes apparent when it is realized 18 species of Oliarus have been described (usually without illustrations) since the last revision by Ball (1934) which was admittedly preliminary in scope, had no illustrations, and was based primarily on female color characters (which have proved unreliable).

The morphological terminology employed in the present paper primarily follows that of R. G. Fennah in his many papers since 1944. Characters of the head are often useful at the specific level but color is variable and length and width ratios of the vertex and frons exhibit infraspecific variation. Carinae may be more elevated in some specimens than in others of a particular species. The length of the rostrum exhibits infraspecific variation but does so within

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limits that usually make it taxonomic value at the species group level, if not at the specific.

The thorax has useful characters, but here again the range of variation of these characters must be understood before much taxonomic reliance can be placed on them. The ground color and carinal color on the mesonotum not only can vary from specimen to specimen, but also may be slightly asymmetrical on an individual. The generic character of five longitudinal carinae on the mesonotum holds true in nearly all specimens of Oliarus, but sometimes the intermediate pair of carinae is either barely existent or obsolete. Venation in the tegmina is erratic, less so in the wings, with differences in venation in both of these between left and right appendages occurring frequently. Tubercles on the tegminal veins differ in size, pigmentation, and spacing, and sometimes are useful taxonomic characters. Spots, bands, stripes, and smoky areas of the membrane are useful characters in those species where the range of variation is understood. Several species have been observed to have translucent or milky subhyaline veins normally, but occasional specimens in the same species have been collected that are vitreous or melanic. Vein color is variable but is consistent enough within a given species to be of use frequently. The stigma usually is elongate and brownish, pale or nearly so in only a few species. The value of the stigma as a taxonomic character is partially limited by its variability in shape and color, and sometimes also by the difficulty in defining its precise boundaries. The legs usually are without reliable characters, but some species have banded front and middle tibiae instead of the usual solid brown. Each posterior tibia (metatibia) usually has three lateral spines but the number and spacing of the spines is variable even from left side to right side on the same specimen. Without exception, in the specimens examined the number of apical spurs on each metatibia is six. The number of apical spurs on the first and second tarsites of each metatarsus usually is seven for each tarsite, including the lateral pair of spurs. Specimens of the Oliarus exoptatus Van Duzee group and the O. cinnamomeus Provancher group not only have more than seven apical spurs, but each one of these spurs except the lateral pair has a scalelike tooth at its apex. These scalelike teeth are discussed in detail by Fennah (1958).

The more external male terminalia consist of the 9th abdominal segment, commonly termed the pygofer; the 10th segment, commonly called the anal segment or anal tube; and the 11th segment which has slight taxonomic usefulness. The more internal terminalia consist of the aedeagal complex, connective, and styles. The connective, lateroventrally, is attached to the styles; dorsally it is attached to the aedeagal apodeme. It has hitherto been neglected as a taxonomic character in Oliarus. The connective appears to have its greatest value in providing additional evidence for discerning groups of species. The aedeagal complex and the styles have been used as taxonomic characters for several decades. The pygofer capsule serves as a support for the male terminalia and provides a rigid medioventral process against which the styles hold the 1st and 2nd valvulae of the female ovipositor during copulation. This medioventral process is so distinctive in some species that specific determinations are sometimes possible from it alone. The process also is valuable in helping define groups of species. The dorsal bridge of the pygofer has slight taxonomic value but is important as the place where the principal attachments of the anal segment and of the periandrium of the aedeagal complex are located. The lateral lobes of the pygofer have characteristic shapes and sometimes are so distinctive that they alone provide sufficient evidence on which to make specific identifications. The outline of the anal segment is useful from dorsal, lateral, and caudal views.

The aedeagal complex has the most valuable set of characters used in present systematic studies. These characters are best seen in ventral view, but most species have at least one dorsal process that should be examined from dorsal aspect. The aedeagal complex consists basally of the aedeagal apodeme extending to the aedeagal joint and enclosed throughout this extent by sheathlike material called the periandrium. The distal part of the aedeagus (beyond the joint) is termed the flagellum and usually bears sclerotized processes, as does the periandrium. The shapes, positions, and number of all of these processes are very important characters, especially at the specific level. The shape and direction of the flagellum proper (ignoring its processes) has taxonomic applications more at the species group level.

The greatest concentration of species of Oliarus in North America is found in the southwestern United States. Arizona has the most species with 22 (7 endemic), followed by Texas with 17 (4 endemic), and California with 16 (4 endemic), but New Mexico has only 6 (none endemic). This low figure for New Mexico probably is the result of limited collecting and possibly a comparative lack of diversity in habitats. Some other totals of species of Oliarus for various states follow: Nevada 5, Utah 10, Colorado 8, Kansas 6, Illinois 8, Ohio 8, New York 4, Connecticut 5, North Carolina 9 (1 almost endemic), Florida 10 (1 endemic). Of the 10 Florida species and 17 Texas species, only Oliarus difficilis Van Duzee is common to both states. In Texas this species is known only from the Lower Rio Grande Valley near Brownsville; in Florida it has been taken in the southern half of the state. O. difficilis is closely related to forms taken in the Antilles and South America. Two other species of Oliarus in Florida have Neotropical affinities (O. slossonae Van Duzee and O. viequensis Caldwell). Another species, O. littoralis Ball, is endemic to Florida but is closely related to forms occurring in Texas. The other Florida species are mostly typical of the eastern (Carolinean) fauna. Most of the species in the western United States appear related to Mexican forms. Three western species and two species primarily eastern in distribution appear related to Palearctic forms.

The following species of Oliarus are recorded in the present paper as present in Canada: aridus Ball; beirnei, new name; cinnamomeus Provancher; dondonius Ball; humilis (Say); sablensis Caldwell; and zyxus Caldwell, a total of nine species (none endemic).

Precise data on the ecology of Oliarus in North America are scarce. The available information suggests that the nymphs are subterranean and feed on the roots of plants. Nymphs of O. quinquelineatus (Say) were collected near roots of Solidago sp. at

Vienna, Virginia, by J. C. Bridwell at various times in 1936 to 1938. O. cinnamomeus (Provancher) apparently is characteristic of bog areas where sphagnum moss and species of Vaccinium are prevalent. O. quinquelineatus (Say) and O. vicarius (Walker) usually have been collected close to pine, Pinus spp. Possibly the nymphs and adults have different food habits, which is not an unusual phenomenon in Homoptera. In Florida the writer has noted that ecological requirements for several of the species seem to be quite exacting. O. sablensis Caldwell is common in a low, herbaceous, pine-flatwood zone downhill from a scrub oak habitat four miles east of Gainesville, but this is the only place in Florida where he has personally collected this species. When collecting for O. viequensis Caldwell, specimens usually have not been found until a low, herbaceous swale rich in grasses has been located in a tidal flat area. O. littoralis Ball also is characteristic of grassy tidal flats. The writer has collected viequensis in greatest numbers on Big Pine Key, Florida, where there are extensive tidal flats having a creeping wiry grass, Monanthochloe littoralis Engelmann. In the western United States O. dondonius Ball is typical on sea blite, Dondia (= Suada) sp. of the arid alkali flats.

In North America no species of Oliarus has been demonstrated to be of economic importance, even though adults have been collected from a variety of vegetable and forage crops, fruits, and ornamentals. Some commercial plants from which Oliarus adults have been taken include: sugarcane, cotton, rice, tomatoes, potatoes, corn, soybeans, eggplant, carrots, beans, asparagus, yams, celery, papaya, apricot, plum, pecan, sunflower, alfalfa, and pasture grasses. Sein (1932,

1933) found nymphs of Oliarus complectus Ball [reported as O. franciscanus (Stål)] feeding on the roots of sugarcane and paragrass in ~~Puerto Rico~~. He could find no economic damage to these host plants. His attempts to implicate O. complectus as a vector of sugarcane mosaic had negative results. From elsewhere in the world, however, Dubovskiy (1965) listed O. leporinus (Linnaeus) along with other Homoptera as known vectors of plant virus diseases. Boyce et al. (1951) in New Zealand, proved that O. atkinsoni Myers can be a vector of the virus that causes yellow-leaf disease of Phormium, an indigenous plant exploited for the fiber industry. Damage by yellow-leaf disease was responsible in part for the deterioration and eventual disappearance of many thousands of acres of Phormium.

Although species of Oliarus do not appear to be involved in damage to plants in the United States and Canada, very little is known about the immatures in this regard. They could have some value as indicators of various ecological conditions and supply additional evidence for studies involving zoogeography.

REVIEW OF THE LITERATURE

The genus Oliarus was erected in 1862 by Stål. Distant (1906) designated a southeast Asian species, walkeri (Stål), as type of the genus. The catalog by Metcalf (1936) is the best compilation of the world's knowledge of Oliarus and other cixiids. Search through this catalog shows the first described Oliarus (a European species) was leporina by Linnaeus in 1761 in the genus Cicada. Fabricius described the first new world species in 1775. This was Cicada villosa from "America meridionali" (South America). However, the status of this species is in doubt partly because Stål (1869) wrote that "the true home of this species probably is southern Russia, from whence I have seen a specimen agreeing with that of Fabricius" (translated from the Latin by the late Prof. R. F. Hussey (University of Florida); furthermore, the type is a female in poor condition.

For the Canadian and United States portions of North America, the first descriptions were by Say (1830). These were Oliarus (=Flata) humilis and quinquelineatus. Walker (1851) described vicarius (in Cixius). Stål (1859) described franciscanus from specimens supposedly collected in California, and since then this name has been applied erroneously to specimens collected from many parts of North America (O. franciscanus is actually a South American species). Provancher (1889) described cinnamomeus, the first North American species described in the nominal genus Oliarus. Later (1902), Ball described aridus, complectus, and sementinus. Of these, complectus has been involved in gross complications. The type series of 25 specimens included such far flung localities as Maryland, Kansas, Arizona, Colorado, and Haiti in the West Indies. Later, Ball (1934) realized his type series was mixed and restricted the type locality to Port Au Prince, Haiti. This was fortunate because his concept of complectus still included certain forms in Florida, southern Arizona and adjacent Mexico which later were shown to involve three species, not just one. O. complectus, in a strict sense, is primarily a Caribbean species. Unfortunately Metcalf concluded research on his 1936 catalog in 1934 without having seen Ball's paper. Metcalf followed the Van Duzee publications, giving complectus as a synonym of franciscanus; therefore, franciscanus in the sense of Metcalf (1936) was still a composite of at least eight or nine species by present day knowledge.

Swezey (1904) included seven species of Oliarus in a catalog of fulgoroids of America north of Mexico. He summarized the references, distribution, habitat, and food plants of the species as they were understood at that time. Some of this information is erroneous; for example, the habitat information associated with complectus and franciscanus is incorrect.

Fowler (1904) described nine species of Oliarus from Central America and Mexico. Two of these species, nigro-alutaceus and concinnulus have been reported in the southwestern United States, but this is discounted as explained below. O. concinnulus appears related to several Canadian, Mexican, and United States species, of later description, referred to hereinafter as the concinnulus group. The description and illustration of O. breviceps Fowler from specimens collected at Juarez in northern Mexico agrees with O. aridus Ball;

and Van Duzee (1916) apparently was correct in synonymizing breviceps under aridus. The other Fowler species of Oliarus probably are too different and too far removed geographically from the United States to be directly involved in this study. The Fowler types are in the British Museum and need a critical study before nomenclature of Neotropical Oliarus can reach stability. This may be difficult because some of the species were based entirely on females, and because the type series is short and of poor quality in some of these species.

Kirkaldy (1907) added pima. Van Duzee (1908) not only described hyalinus as a new species but also prepared the first key to the species of Oliarus in Canada and the United States. However, of the 10 species listed, 3 were unknown to him, hence his key included only 7 species. His descriptions and notes on the various species were well done and generally accurate except for some confusion on complectus. In 1912 Van Duzee published slossoni as a new name for hyalinus and added two new species, placitus and difficilis. Barber (1914) listed six species of Oliarus in Florida, but one of these, complectus, perpetuated an erroneous record first made by Van Duzee (1909). Van Duzee (1914) added californicus and fidus. He synonymized complectus under franciscanus in 1916. Then in (1917a) he described hesperius and exoptatus. He mentioned hesperius as the as the species he had formerly determined as franciscanus, and noted that after a careful study he was convinced "Stål's species [franciscanus] must be the complectus of Ball."

Van Duzee (1917b) prepared a catalog of Hemiptera which included references and geographic distribution for the entire 13 species of Oliarus known at that time for Canada and the United States.

Metcalf (1923) prepared a profusely illustrated key to the North American fulgoroids ranging in the territory lying east of the foothills of the Rocky Mountains. He included descriptions of new species, four of which were in Oliarus. These were montanus, vitreus, texanus, and vittatus. Thirteen species of Oliarus were recognized in this Metcalf key. There has been considerable confusion surrounding texanus and vittatus; however, I have seen the type material and find that the holotype male of texanus is essentially correct as described and illustrated by Metcalf and that two male paratypes are conspecific with the type. The paratype female of texanus belongs to difficilis Van Duzee. The holotype male of vittatus is difficilis and the allotype female is texanus. The drawings of difficilis in Metcalf are of the form described by Caldwell in 1947 as O. eximus teximus.

In 1923 Van Duzee prepared a key to the four species he recognized as occurring in Connecticut. He presented brief notes on morphology, range, and habitat. The reference to franciscanus (Stål) is erroneous and probably refers to ecologus and/or sablensis. Leonard (1928) listed five species of Oliarus in New York State, and of these, O. placitus Van Duzee is listed erroneously as shown below.

Dozier (1928) prepared a key to nine species of Oliarus known to occur or believed of possible occurrence in Mississippi, adding biosystematic data. Erroneous information included the listing of slossoni Van Duzee as abundant in Mississippi. The drawing and the comments actually refer to aridus Ball. Also incorrectly identified were franciscanus (Stål) and humilis (Say), which were ecologus

Caldwell and chuliotus Ball, respectively. Van Duzee (1929) described his last Oliarus, O. truncatus.

In 1934 Ball published the most important single work on Oliarus in North America. He described 10 species as new, but one of them [nogalanus] was subsequently synonymized. He submitted a preliminary key, with distributional notes, to 31 species of Oliarus, but recognized only 28 as occurring north of the Mexican border. Ball disdained the dissection of male genitalis; therefore, his key characters were based on the easily seen external structures and colors of specimens. He was handicapped by not using characters of the aedeagal complex; thus, several of his couplets fail to separate two or three closely related species. Ball attempted to clarify the Fowler species and appears correct on some and incorrect on others. The task of fully delineating the Fowler species still remains. It is certain that Ball's action in synonymizing texanus Metcalf under concinnulus Fowler was incorrect. Fennah (1945) published drawings by W. E. China of the male genitalia of the type of concinnulus, and this clearly establishes the wide difference between this species and texanus Metcalf. Ball correctly placed the female allotype of vittatus Metcalf as a female texanus Metcalf, before mistakenly reducing texanus to synonymy under concinnulus. Ball also resurrected his complectus, listing lacteipennis Fowler, humeralis Fowler and franciscanus in the sense of Van Duzee as synonyms. His action on the Fowler species was based on study of the printed descriptions, not the actual types. He correctly realized the original type material of complectus was mixed but failed to realize there were two other species remaining in his new concept of complectus. Ball wisely decided to consider franciscanus Stål as an unknown until the type could be studied. He also realized that the holotype male of vittatus Metcalf must be the male of difficilis Van Duzee. In Ball's key, pima Kirkaldy should be changed to sonoitus Ball and nogalanus Ball should be corrected to pima, as will be shown below. The new species added by Ball in 1934 were, in page order: chuliotus, papagonus, nogalanus (in error), corvinus, yavapanus, coconinus, littoralis, apache, altanus, and dondonius.

Metcalf published his catalog in 1936, but the preparation of the manuscript stopped in 1934 before Ball's important 1934 paper was available. In his catalog, Metcalf listed lucidus as a new name for vitreus Metcalf, which is treated as an unknown in this present revision because the species is known only from the type material and the types appear lost, and because the description does not certainly match any well known species with which lucidus could be synonymized. Ball thought the description of lucidus closest to quinquelineatus (Say) or vicarius (Walker). With this I agree.

Ball (1938) added sonoitus and pygmaeus and corrected a portion of his 1934 key resulting from his subsequent study of Kirkaldy's mixed type series of pima. Ball stated that new species sonoitus was the species he keyed out as pima Kirkaldy in his 1934 paper and that most of the pima type series was what he (Ball) described as nogalanus. If I interpret Ball's remarks correctly, nogalanus Ball should be synonymized under pima Kirkaldy. I have seen the presumed type series of pima, and the types of nogalanus and sonoitus. O.

sonoitus is distinct, whereas nogalanus is the same as pima. Brimley (1938) listed 10 species of Oliarus in North Carolina, including O. aridus Ball as questionably present. The author confirmed the presence of aridus in North Carolina during a collecting trip to Morrow Mountain State Park in 1959. The North Carolina records for O. cinnamomeus Provancher, O. difficilis Van Duzee, O. franciscanus Stål, and O. slossoni Van Duzee are in error; O. vitreus Metcalf remains an unknown until such time as the types are discovered.

Osborn (1938) included a key to the Ohio species of Oliarus as part of a larger work on Ohio fulgoroids. Supplementing the key were illustrations, descriptive notes, and distributional data on five Ohio species and two more of possible occurrence. A number of discrepancies are involved in the drawings. The sexes are reversed in the captions of figures 13 c and d. Drawings 14A, 14B, 14C, 14D and 14E of ventral views of the male genitalia exhibit mirror images of the aedeagal complex. The styles of placitus (figure 14B) are represented as symmetrical but actually are moderately asymmetrical. Figures of franciscanus (14C and C') are actually ecologus Caldwell and the records listed for franciscanus apply to a mixture of ecologus and sablensis.

Caldwell (1938) added nigravittus and lobatus. I have examined the holotype male of nigravittus and consider it the same as sonoitus Ball, and the synonymy is made below.

Fennah (1945b) prepared a paper on the Cixiini of the Lesser Antilles. The full impact of this work on North American Oliarus is yet to be evaluated and involves regions and generic considerations mostly beyond the scope of the present revision. However, his description of _Melanoliarus_ as a new subgenus of _Oliarus_ is well merited and accommodates three species in this paper: _complectus_ Ball, _acicus_ Caldwell, and _viequensis_ Caldwell. The one new species of _Oliarus_ described by Fennah in this paper was _campestris._ I agree with Caldwell (1952) that _compestris_ is properly placed in synonymy under _complectus_.

Caldwell (1947a) described _acicus, ecologus,_ and _zyxus,_ then (1947b) added _eximus eximus, eximus teximus, forcipatus, catus, retentus_, _bispinus, uncatus,_ and _sylvaticus_ for the United States, plus other species from Mexico.

Beirne (1950) added _artemisiae_ (a preoccupied name) and included a key, illustrations, distribution, and notes on _Oliarus_ in Canada. He treated seven species. His illustrations of the male terminalia of _franciscanus_ appear to have been made from _coconinus_ Ball. The drawings labeled _ecologus_ Caldwell are _sablensis_ Caldwell.

Caldwell (1951) described _sablensis, gladensis,_ and _altanatus,_ and added a new name and a new species for Mexican forms not reaching the United States. _O. gladensis_ Caldwell is placed in synonymy under _chuliotus_, below.

Caldwell and Martorell (1952) added _viequensis_ Caldwell, illustrated and defined _complectus_ Ball, and described _borinquensis_ Caldwell as a new species from Puerto Rico. The last is the same as _slossoni_ Van Duzee described from Florida, and is synonymized later in the present treatment.

MATERIALS AND METHODS

Specimens were obtained on loan from individuals and institutions as noted under acknowledgements. Most of the type material was concentrated at the United States National Museum, Washington, D. C., the Ohio State University, Columbus, Ohio, and the California Academy of Sciences, San Francisco, California. Several trips to study type material and facilitate loans were made to the U. S. National Museum and Ohio State University. Several hundred specimens were collected in the field primarily at Gainesville, Florida and tidal flat situations as far south as Key West, Florida. Numerous specimens were presented to the author by his colleagues, especially by Dr. D. H. Habeck and Dr. R. E. Woodruff (mostly specimens from blacklight traps operated in Florida and Mexico). Most of the holotypes were examined through the generous cooperation of curators who loaned types for a few weeks even though their museums were hundreds or thousands of miles away from Gainesville, Florida. In those specimens where the types were not seen, the author examined paratypes, relied upon the original description, opinions of the first reviser, subsequent descriptions, and helpful comments by the current curators who examined the types at my request.

Pinned specimens to be dissected were inverted on an artgum eraser in which a hole had been bored to receive the upper portion of the pin, thus allowing the specimen to rest flat on the surface of the eraser, ventral side up. Under low power of a dissecting microscope, a flattened needle was pressed against the sturdy pygofer ring to separate the abdomen from the thorax. If this separation did not occur readily, the needle was inserted at an angle along the connection between the thorax and abdomen. Shattering or flipping of an abdomen was prevented by wetting with 75 percent isopropyl alcohol shortly before attempting the dissection. Relaxation of specimen in a moist chamber overnight had some benefits but abdomens of such specimens usually were difficult to separate from the thorax.

It is my experience that it is easier to effect a clean separation of abdomen from thorax in leafhoppers (Homoptera: Cicadelloidea) than on planthoppers such as Oliarus. The connecting surface between the abdomen and thorax in leafhoppers is approximately at right angles to the long axis of the body, but in Oliarus the connecting surface is diagonal to the long axis, making it more difficult to use the needle against the connection of the slanting dorsal surface of the posterior ventral extension of the thorax.

The entire abdomen was placed in cold 10 percent aqueous potassium hydroxide overnight to clear the abdomen (usually 8 hours minimum, 20 hours maximum). Next the abdomen was placed in distilled water for approximately 10 minutes, then transferred for 10 minutes to water weakly acidulated with acetic acid and finally to weakly acidulated glycerine for dissection or permanent storage. If further dissection was necessary, a small amount of boric acid ointment was placed on the bottom of a deep well slide, glycerine was added, then the abdomen was placed in the depression and dissected. Dissected parts were placed in the desired orientation on the ointment for drawing. Tools for dissections included a pair of stainless steel English needles, jeweler's forceps and a minuten pin ground to a blade by an electric grinder. The instruments were used to tear connecting membranes and to separate the various structures at their points of articulation. Ordinarily the most difficult dissection occurred at the two locations on the dorsal part of the pygofer where the sclerotized periandrium was firmly attached. Near each connecting point the pygofer was held firmly by the forceps while the bladelike minuten pin was used to cut the connecting tissue. If the pygofer was held too far away from the point of articulation the strain on the pygofer was sometimes excessive during the cutting operation, and the pygofer was torn. Most of the structures were illustrated at right angles to a lateral, dorsal, or ventral surface, but the styles were illustrated in broadest aspect to show the inner surface and process. In situ, a right angle to this broadest aspect would extend in a dorsolateral direction. There is merit in drawing the styles in situ, but it is believed that the detail of the inner processes is especially important and best seen from the dissected style in broad aspect, upper view. Upon completion of drawings, the dissected parts were placed in the abdomen and this, in turn, placed in a microvial with a drop or two of glycerine in the bottom, with care to make sure no glycerin touched the cork or stopper. The microvial was then placed at a downward angle on the pin of the specimen to which the dissected parts belonged.

Drawings were made by using a Zeiss camera lucida drawing instrument placed on the photographic adapter tube of a Bausch and Lomb compound microscope. This camera lucida instrument has two polarizing light adjustments which greatly expedite the proper balancing of refracted light from the microscope and relected light from the drawing surface. Drawings were made by fine pencil on 100 percent cotton fiber tracing paper. The camera lucida drawings were checked for accuracy by comparing the drawing with the specimen. The drawings were not made to scale but were enlarged to a point where they were in a certain size range. Many drawings were prepared for study and reference purposes only. More than 3000 such drawings are on file. Drawings of types or other specimens used to represent the species were given to Mrs. Phyllis P. Habeck, who transferred the drawings to No. 2 Bristol Board and inked them under my supervision. Any discrepancies in the drawings are the responsibility of the author. The drawings of the aedeagal complex involved some hand stippling by crowquill pen to emphasize the processes, then the whole complex was covered by Zip-a-tone Z306 to give a uniform stippled effect. Mrs. Habeck had used this technique successfully in her work for Dr. J. L. Gressitt and Dr. D. Elmo Hardy in Hawaii. Photographs of the drawings were made through the courtesy of the Information and Education Section of the Division of Plant Industry, Florida Department of Agriculture. Drawings reproduced here are reduced to approximately one-third of their original size. The paper used for the prints was made by the Foto Rite Company, having the code name Foto/Line MP 3.

Nearly all the research was done at Gainesville, Florida, in the headquarter facilities of the Division of Plant Industry, Florida Department of Agriculture.

GENUS OLIARUS STÅL

Oliarus Stål, 1862. Berl. ent. Z. 6:306.

Type-species of the genus Cixius walkeri Stål by subsequent designation of Distant (Fauna British India 3:256, 1906).

Total length of North American forms varying from 3.0 to 8.5 mm. Head somewhat narrower than thorax, angularly emarginate at the base, vertex concave, longer or shorter than width between the eyes, usually longer, lateral carinae diverging posteriorly, with or without a median carina extending forward from the base; vertex with an angulate or arcuate transverse carina near apex and a frontal carina at apex, the transverse and frontal carinae usually joined (sometimes feebly) by two longitudinal carinae, the four carinae thus forming two lateral foveae and a small rectangular or square pit or compartment between; face with epistomal suture, arched dorsally, the frons and clypeus together broadest at about the midlength of face; frons and clypeus together elliptical in shape; base of anteclypeus marked by introrse termination of lateral facial carinae; a median carina traversing face from apex of anteclypeus to basal area of frons where a fork or thickening occurs, forming a small triangle which becomes obscure in species having tumid face; elevation of median carina varying from very conspicuous in some species to obsolete or nearly so for part its length in other species; median ocellus present and usually conspicuous at juncture of frons and postclypeus; rostrum varying in length from definitely not attaining caudal margin of posterior trochanters to surpassing trochanters by as much as most of length of terminal segment of rostrum.

Thorax with pronotum short and tricarinate, posteriorly deeply and angulately emarginate in median area, curving laterally; mesonotum with five longitudinal ridges, intermediate pair sometimes nearly obsolete; tegmina at rest longer than the abdomen, each broadly rounded at the apex, vein Sc + R contiguous at base with M, fork of M_{1+2} nearer to fork of M than is the fork of M_{3+4}, setae confined to veins, not on membrane, usually with 10 to 12 apical cells and 5 or 6 anteapical cells; posterior legs with variable number of conspicuous lateral tibial spines usually three, first and second tarsites normally with seven apical spurs, but some species with additional spurs having membranous scale teeth attached distally to all the spurs except the lateral pair.

Male terminalia with base of periandrium firmly articulated at two points on the dorsal bridge of the pygofer in most species, but fastened to upper lateral portions of pygofer in a few species, attachment to base of anal segment weak, non-sclerotized; anal segment firmly attached to and articulated with dorsal bridge of pygofer, shape of anal segment varying from narrow and flaplike to broad and hoodlike; often slightly asymmetrical; styles often asymmetrical, loosely connected with each other, capable of independent movement; medioventral process of pygofer greatly variable in shape and size; connective varying from long and slender to short and stout, sometimes asymmetrical, combined width of ventral arms varying from conspicuously greater than, to less than width of base in posterior view; aedeagal complex with periandrium well developed and having great variety of shapes and processes, aedeagus with conspicuous apodeme normally articulated posteriorly with flagellum, the latter directed at various angles to the left when it is viewed in the non-mating position from ventral view, flagellum usually having several processes. The genus is cosmopolitan and rich in species.

In North America, males of Oliarus are set well apart from other genera by the combination of a comparatively broad vertex, angulate emargination of the posterior part of the head, five (rarely three) longitudinal carinae of the mesonotum, lack of setae or fuscous granules on the membrane of each tegmen, main attachment of periandrium to pygofer rather than base of anal segment, and styles independently movable, with projections, and not flattened.

Curators and other persons desiring to separate Oliarus from other North American genera of Cixiidae are referred to the keys provided by Metcalf (1923) and (1938). Not included in these keys is Oliaronus Ball (1934). This genus is very closely related to Oliarus, especially the aridus Ball group. The male terminalia of Oliaronus tontonus Ball, type-species of the genus, are very similar to Oliarus pima Kirkaldy except for the presence of a very slender, moderately long, ventral process of the periandrium which is not present in pima. Oliaronus is the only North American cixiid genus which, like Oliarus has the posterior margin of the vertex deeply angulate and parallel to the posterior margin of the angulate pronotum. All the other genera except Oliaronus have the posterior margin of the vertex broadly rounded (concave). Oliaronus is separated from Oliarus by its unusual tegmina in which much of the costal cell is thickened, darkened, and thickly beset with heavy setigerous tubercles. Species of Oliarus do not have this thickened area nor tubercles in the membranous areas between veins such as are found in the costal and outer discal cells of Oliaronus.

Another striking characteristic of Oliaronus is the series of seven or eight long narrow oblique cells between the node and the radial sector. The available specimens of Oliaronus are all from the southeastern quarter of Arizona.

In addition to Oliaronus the Nearctic genera most often confused with Oliarus are Cixius, Oecleus, and Haplaxius (=Myndus). Cixius and closely related genera never have more than three mesonotal carinae. Oecleus has five mesonotal carina as does Oliarus, but the vertex of Oecleus is very narrow with sides almost touching at the base, and Oecleus along with the tricarinate Haplaxius have no spines on the posterior tibiae before the apex, whereas Oliarus has two or three.

Many of the North American species of Oliarus are sufficiently similar to certain other members of the genus that groupings of species can be effected. Other species seem too distantly related to permit assignment to a group.

The largest group is the Oliarus aridus group consisting of the following 15 species: aridus Ball, hesperius Van Duzee, kieferi, new species, pima Kirkaldy, sonoitus Ball, californicus Van Duzee, sementinus Ball, canyonensis, new species, retentus Caldwell, truncatus Van Duzee, apache Ball, papagonus Ball, caldwelli, new species, and lobatus Caldwell. These species are characterized by the extensive length and uniform curving of the flagellum to apparently form a loop as seen in ventral aspect. Most of the species in the aridus group are southwestern in distribution, aridus being the only one to range east of Texas, moreover, it is the most ubiquitous Nearctic Oliarus. On the west coast, only aridus and hesperius are known to extend as far north as Oregon. Some of the more important characteristics that separate species within the aridus group are presence or absence of a process on the inner margin of the flagellar loop, number of processes on the flagellum and the number of these that are apical, number of processes on the ventral periandrium, presence or absence of a process on the dorsal periandrium, whether or not the dextral periandrial process is forked, width of the vertex, type of spotting and banding of the tegmina, color of veins and size of the tubercles on the veins, shape of the macula and width of the frons on the face, along with other characters.

The Oliarus cinnamomeus group consists of two closely related species, the other species being habeckorum, new species. Several outstanding characteristics set these two apart from other Nearctic species as follows: the dextral process is very long, extending not only caudad, but curving left and cephalad in an unusual manner for American species; the sinistral process is a platelike structure extending from the ventral to the dorsal surface; the first and second tarsites of the metatarsi have more apical spurs than the usual number of seven in most American forms, and each of these spurs except the lateral pair has a membranous scalelike tooth on the distal portion. Members of the cinnamomeus group have uniformly colored light brown or dark brown tegmina. The styles are unusual in the way that the inner ridge or "process" arises abruptly from the shaft and does not terminate in a lobe or digitate process as in most species. These two species are comparatively rare and range primarily in the eastern and northeastern areas of the United States. The habitats are bogs or other damp places. If the political boundaries of North Carolina were enlarged by one or two counties, habeckorum could be considered endemic to North Carolina on the present evidence.

Although much different from the Oliarus exoptatus Van Duzee group, the cinnamomeus group may be closer to the exoptatus group than to any other in the Nearctic region. Both groups are characterized by a broad vertex and by more than the usual number of apical spurs (for American species) on the first and second tarsites of the metatibiae.

Species in the Oliarus exoptatus group are beirnei, new name, exoptatus Van Duzee, and fidus Van Duzee, all western in distribution. These species are very close to one another and need more study. As treated in the present paper, beirnei ranges from southwestern British Columbia southward to central California; exoptatus ranges in the northern half or two-thirds of California, the Lake Tahoe area of Nevada, and in isolated areas of the northern Rocky Mountain system in the United States; fidus seems confined to the southwestern corner area of California. The exoptatus group is characterized by a high degree of asymmetry in the styles, and by the attachments of the periandrium and anal segment to the pygofer. The anal segment is not attached to the median posterior margin of the dorsal bridge of the pygofer as is usual, but instead off-center to the left. The base of the periandrium is so extremely broad that the points of attachments have evolved from the narrow dorsal bridge to the wider accommodation provided by attachment to the upper sides of the pygofer. The attachment to the left side of the pygofer is slightly more dorsad than on the right. The flagellum in the exoptatus group is characterized by three processes, none of which is apical, the most unusual process of the three being long, slender, curving process arising ventrad at the base of the flagellum. One of the unusual characteristics of the periandrium is the spherical development on the right basal portion which in ventral aspect appears as a convexity, in dorsal aspect as a concavity. The anal segment in the exoptatus group is moderately asymmetrical in dorsal or caudal view. A distinguishing feature of the anal segment is the broad and deep subrectangular excavation of the apex, with the median portion directed ventrad in a truncate process. The connective in the exoptatus group has a characteristically different shape from other Neartic species.

I have compared species of the exoptatus and cinnamomeus group with a few European specimens and with some of the illustrations of European Oliarus. Both the exoptatus and cinnamomeus groups seem closer to Palearctic than to other Nearctic forms. There is a need for a more comprehensive comparison of Asiatic and European forms with those of the Nearctic region.

The Oliarus placitus group consists of placitus Van Duzee, montanus Metcalf, eximus Caldwell, and teximus Caldwell. The last two species are southwestern in distribution, the first two have been collected in the eastern half of the United States. One of the outstanding characteristics of males in this group is the greatly expanded pygofer process. Other group characteristics include the short, stout connective having unusually long ventral arms, and often with the base of the connective tilted, that is, not at right angles to the long axis of the shaft; styles which usually are apically bilobed, asymmetrical, and long and arcuate in situ; flagellum and periandrium so intimately fused that it is difficult to separate the two structures; the flagellum extending primarily caudad, and slightly curved to the left; and tegmina with veins intermixed pale and dark throughout.

Somewhat allied to the Oliarus placitus Van Duzee group is the closely related pair of species quinquelineatus (Say) and vicarius (Walker).

These two species do not have the greatly expanded pygofer process, nor unusual connectives or styles, but they do have the basic structure of the aedeagal complex much as in the placitus group. The great array of spines on the aedeagal complex of quinquelineatus and vicarius is distinctive and one of the most peculiar and astonishing developments to be seen on any species of Oliarus in the world. O. vicarius is characteristic of the coastal plain from Florida to North Carolina; O. quinquelineatus ranges over much of the eastern United States, with vicarius mostly replacing quinquelineatus in the coastal plain but with some sympatry occurring and the species maintaining their close but distinctive characteristics. Both species seem to be associated with pine trees but it is not known if this association is obligatory.

The Oliarus yavapanus group of species includes forcipatus Caldwell, uncatus Caldwell, as well as yavapanus Ball, all from the southwestern United States. The general appearance, styles, anal segments and pygofers are sufficiently similar among the three species that separation depends upon characters of the aedeagal complex. Group characteristics of the aedeagal complex include a periandrium with moderately developed sinistral and dextral processes, a medioapical ventral process, a moderate-sized mediobasal dorsal process, and especially the short mediobasal process of the venter. The flagellum has a single apical process and a single caudopreapical process in the three species.

Subgenus Melanoliarus Fennah (1945b) includes O. complectus Ball, viequensis Caldwell, and acicus Caldwell. O. complectus and viequensis are Antillean species that extend into Florida. O. acicus ranges in northern Mexico and in the southwestern United States close to the Mexican border from Texas to California. The most obvious characteristic of this group is that the anal segment of the male has an acute apical tooth directed ventrally and somewhat anteriorly. Another important characteristic is the basal ring of the periandrium which gives rise to two or three short processes ventrally and laterally. Species in this subgenus are small, have most parts of the head and thorax dark brown or black, and have tegmina nearly immaculate.

The *Oliarus chuliotus* group includes *bispinus* Caldwell, *sablensis* Caldwell, and *chuliotus* Ball. This group is characterized by the sclerotized medial area of the dorsal periandrium being expanded into an unpaired biramous process, the ventral periandrium having four conspicuous processes, and the flagellum with none to two processes. The other male terminalia are without unusual shapes or appendages. *O. bispinus* is a rare species in southwestern Texas, while *O. sablensis* and *O. chuliotus* are eastern species very closely related. These two species exhibit considerable sympatry, but apparently they have not been discovered together in any one habitat. Both species seem to be locally abundant but scarce generally. The habitat requirements apparently are rather specialized. Of the 67 counties in Florida, there are records of *O. chuliotus* in five, *O. sablensis* in seven, but only two of these, Dade and Seminole Counties, are common to both species. *O. chuliotus* has been taken in nine states plus District of Columbia. *O. sablensis* has been taken in 20 states (in 6 of which *chuliotus* occurs), District of Columbia, and Ontario and Nova Scotia in Canada. *O. sablensis* extends several hundred miles farther north and northeast than *chuliotus*. The latter, however, has a more southwestward distribution. In the *chuliotus* group there is a tendency toward a clinal increase in the number of flagellar processes along a diagonal line from southwest Texas to northeast United States. *O. bispinus*, the Texas species, has no flagellar processes; *O. chuliotus* next along the diagonal line has one flagellar process; *O. sablensis*, which overlaps in range with *chuliotus* and becomes the only species on the northeastern part of the diagonal line, has two flagellar processes. The high concentration of records in the eastern United States suggests that the *chuliotus* group is a part of the Carolinean fauna, but derivation from the Mexican fauna cannot be discounted. As yet, no Mexican, Central American, or Antillean forms have been observed that resemble the *chuliotus* group. *O. ecologus* Caldwell resembles members of the *chuliotus* group but the aedeagal complex of *ecologus* is considerably different.

The last group recognized in the present paper is the *Oliarus concinnulus* Fowler group. *O. concinnulus* apparently occurs only in Mexico but is closely related to six species whose ranges include the United States. These are *altanatus* Caldwell, *corvinus* Ball, *dondonius* Ball, *littoralis* Ball, *sylvaticus* Caldwell, and *zyxus* Caldwell. They are all western and southwestern species except *littoralis* which is endemic to Florida in tidal flat situations. It is presumed that geologic events were instrumental in isolating precursors of *littoralis* from other members of the group. One of the outstanding characteristics of the *concinnulus* group is the left-caudad enlargement of the sinistral process, often in the form of an "outside" pair of calipers. This structure is highly variable as shown in Figures 153 to 176. This caliperlike process has been one of the principal structures used to separate species of this group. More work is needed to augment the somewhat inconclusive evidence provided by the variable caliperlike sinistral process. Other distinctive group characters include two apical processes and a smaller subapical process on the flagellum. Most of the species in this group have spicules on the sinistral process, O. dondonius and altanatus being the principal exceptions. O. concinnulus, itself, may or may not have spicules. The dextral process varies infra- and interspecifically. O. concinnulus and altanatus are notable for the extremely slender dextral process. Most of the habitat information available on the concinnulus group shows the various species associated with alkaline areas.

Other species of Oliarus in the present paper which have not been assigned to groups are: altanus Ball, arizonensis, new species, catus Caldwell, coconinus Ball, difficilis Van Duzee, ecologus Caldwell, humilis (Say), pygmaeus Ball, slossonae Van Duzee, and texanus Metcalf.

KEY TO MALES OF NORTH AMERICAN *OLIARUS*, NORTH OF MEXICO

1. Flagellum in ventral aspect appearing to form a loop by curving left, cephalad, then right to disappear behind dorsal surface of aedeagal complex, usually with tips of one or two apical processes visible to the right side (Figure 35) 39

1'. Flagellum in ventral view not completing full loop to disappear behind dorsal surface of aedeagal complex (Figure 7), and seldom with the tip of one apical process visible on the right side 2

2(1'). Flagellum in ventral view making only a slight bend to the left in relation to body axis (Figure 75); pygofer process greatly expanded or not; comparatively large species, minimum length 4.5 mm, usually over 6.0 mm. 34

2'. Flagellum various but extending or curving left almost or more than 90 degrees in relation to body axis, for at least part of its length, (Figure 7); pygofer process not greatly expanded; length varying but most specimens not over 6 mm. 3

3(2'). Pygofer process cylindrical in ventral view, extending posteriorly as far as apices of abbreviated lateral lobes, and with a preapical ventral transverse keel; interior, basal portion of right side of ventrum of periandrium with spherical expansion (concave when viewed dorsally); styles with inner process highly developed and grossly asymmetrical; anal segment with medioapical portion broadly and deeply incised in dorsal view, the median portion directed nearly straight downward forming a broadly truncate ventral process as seen in caudal view (Figure 565) (exoptatus group) 32

3'. Pygofer process rarely extending posteriorly as far as apices of pygofer lobes, if so, not cylindrical and without subapical ventral, transverse keel; right ventral basal portion of periandrium without spherical expansion; styles various, seldom, if ever, with both inner processes so large and grossly asymmetrical; anal segment not with combination of broad and deep apical excavation and truncate caudoventral process 4

4(3'). Anal segment forming a medioapical recurved spine or process directed ventrocephalad (Figures 505, 557) (Subgenus Melanoliarus) 30

4'. Anal segment with posterior margin not developed as a prominent downward recurved spine 5

5(4'). Dorsomedian area of periandrial mass occurring as two prongs or processes, one directed more or less to the right, the other more or less to the left (Figures 111, 113, 115, and 118) (chuliotus group). . 28

5'. Dorsal periandrial tissue various, but not occurring as above 6

6(5'). Aedeagal complex ventrally with left side of periandrial mass (sinistral process) usually developing into a conspicuous, highly variable, caliperlike or cheliform process; dorsally with long process directed caudad from base of periandrium, and flagellum with three apical to subapical processes (Figures 137-144, 153-176) (concinnulus group) 22

6'. Aedeagal complex without the above combination of characters 7

7(6'). Aedeagal complex with venter of periandrium having a short, basal process lying between well-developed processes of right and left side and with dorsal periandrium having a mediobasal, moderately long, slender process (Figures 92-97) (yavapanus group) . . 20

7'. Aedeagal complex without the combination of ventral mediobasal process and the dorsal process of the periandrium as described above (Figures 90, 91) 8

8(7'). Left side of periandrium developed into a platelike structure or process that extends from the ventral to the dorsal surface (Figures 68-71) 19

8'. Left side of periandrium without the dorsoventral, vertical, platelike process 9

9(8'). Dorsum of periandrium without processes (Figures 73, 101) (exclusive of right or left side processes that may curve dorsad, or of any basal, downcurving processes of flagellum) 14

9'. Dorsum of periandrium with one or two processes (Figures 78, 80) 10

10(9). Dorsum of periandrium with two long sinuate processes; apex of venter of periandrium with curving, hyaline process (easily overlooked) . . . . ecologus Caldwell

10'. Dorsum of periandrium usually with only one process, but if with two, not with both processes long and sinuate; apex of venter of periandrium without a hyaline process 11

11(10'). Style with mesal margin of shaft greatly swollen (Figure 223); apex of flagellum with a pair of subequal processes forming an inverted "V" (Figure 80) . . . . difficilis Van Duzee

11'. Style with mesal margin not greatly swollen (Figure 247); apex of flagellum with only one process (therefore, without inverted "V") although sometimes with subapical process slightly overlapping apical one (Figure 107) 12

12(11'). Anal segment with a pair of short points at apex (Figure 454); dorsum of periandrium with stout process originating in mediobasal area, this process usually spathelike (Figure 107) . . . . . . coconinus Ball

12'. Anal segment regularly convex or concave, not forming pair of short points; dorsum of periandrium with mediobasal process narrow, not stout and spathelike (Figure 109) 13

13(12'). Left basal lateral area of ventral periandrium poorly developed as a short protuberance and with its mesal apical portion giving rise to a large left-curving process as in Figure 108; dorsum of periandrium apically giving rise to a long, conspicuous curving process directed left-cephalad, and basally giving rise to a short, narrow process (Figure 109) . . . . catus Caldwell

13'. Left basal lateral area of ventral periandrium not poorly developed but giving rise to a conspicuous process reflexed in its apical third and with its mesal apical portion giving rise to a long unevenly curved slender process (Figure 77); dorsum of periandrium without a long, curving process arising apically but basally giving rise to a long, slender process directed posteriorly . . . . humilis (Say)

14(9). Styles asymmetrical, the left one either with a much longer inner process or with an extra process (Figures 215, 245) 15

14'. Styles essentially symmetrical 16

15(14). Left style with long, lobelike inner process attaining outer margin of style and without an extra toothlike process on expanded apical portion (Figure 215); aedeagal complex with prominent dextral processes (Figure 72) . slossonae Van Duzee

15'. Left style with short inner process not nearly attaining outer margin of style and with an extra toothlike process on expanded apical portion (Figure 245); aedeagal complex without dextral processes (Figure 102) . . . . altanus Ball

16(14'). Periandrium with left, basiventral process irregularly serrate, broad and somewhat anvil-shaped (Figures 98, 99); pygofer in ventral view with process extending as far posteriorly as lateral lobes, the process at base approximating width of a lateral lobe (Figure 347) . . . . arizonensis, new species

16'. Periandrium without a left basiventral, irregularly serrate, broad, anvil-shaped process not extending posteriorly as far as lateral lobes of pygofer, but if near that length then obviously narrower than width of a lateral lobe in ventral view (Figure 343) . 17

17(16'). Periandrium on the left with an asymmetrical, Y-shaped process, the outer ramus fairly straight and slender and directed approximately 45 degrees left-caudad, the inner ramus shorter, usually with a protuberance and directed to the right (Figure 91); style with basal mesal margin considerably expanded (Figure 233) . . . . <u>texanus</u> Metcalf

17'. Periandrium on the left not forking apically (Figure 62); style with basal mesal margin of shaft but little expanded (Figure 204) 18

18(17'). Flagellum directed to the left, then cephalad for only a short distance, and with two subequal processes at apex (Figure 100); left apical portion of periandrium with two long processes directed cephaloventrad (Figures 100, 101); total length unusually short (3.5 mm or less) . . . . . . <u>pygmaeus</u> Ball

18'. Flagellum directed left but curving considerably cephalad and slightly to the right thereby nearly forming a loop with one apical process, and having one preapical process about halfway around left margin of loop; total length 3.7 mm or more . . . . <u>papagonus</u> Ball

19(8). Aedeagal complex with a short, slender process arising at the left ventral subapical portion of the periandrium, the tip of this process ending to near apex of the platelike process (Figure 71);

remainder of aedeagal complex with four conspicuous pointed processes; anal segment nearly symmetrical in caudal view (Figure 532) . . . . . cinnamomeus Provancher

19'. Aedeagal complex without a short, slender process at the left, ventral, subapical portion of the periandrium (Figure 68); remainder of aedeagal complex with five conspicuous pointed processes; anal segment distinctly asymmetrical in caudal view (Figure 531) . . . . habeckorum, new species

20(7). Flagellum with a total of three processes including a caudodorsal basal short process (Figure 93); left portion of periandrium with a large, non-bifid process pointing to the left and avicephaliform in profile (Figure 92, 93) . . . . yavapanus Ball

20'. Flagellum with total of two processes and without a caudodorsal basal short process (Figure 95); left portion of periandrium becoming bifid, not avicephaliform in profile (Figure 94) 21

21(20'). Flagellum with the non-apical process much wider in basal half, arising dorsocephalad and directed left-cephalad . . . . forcipatus Caldwell

21'. Flagellum with the non-apical process rather slender and short, arising caudad and directed to the left . . . . uncatus Caldwell

22(6). Periandrium with dextral process straight and extremely slender (Figure 130); dorsum of periandrium with mediobasal process long, slender, directed caudad then curving to the left (Figure 132) 23

22'. Periandrium with dextral process straight or curved but not extremely slender (Figures 133, 135); dorsum of periandrium with mediobasal process usually straight, sometimes with apical third bending slightly to left (Figure 141) 24

23(22). Periandrium with sinistral process only slightly suggestive of an "outside" caliperlike structure, the apical prong clavate, and making only slight curve to the right; basal prong of caliper much weaker and more slender than apical prong or shaft between prongs (Mexican species, no valid United States records; see Figure 56 in Fennah (1945b) . . . . <u>concinnulus</u> Fowler

23'. Periandrium with sinistral process in the form of large, well-defined "outside" caliperlike structure, the apical prong slender and making at least a 90 degree curve to the right; basal prong of caliper only slightly shorter than apical prong (Figure 131) . . . . <u>altanatus</u> Caldwell

24(22'). Periandrium with sinistral process moderate-sized, asymmetrically bifid, not in form of "outside" caliper but suggesting a concave anvil (Figure 133); medioventral periandrial process somewhat variable but always unusually broad at base and neck, curving to the left, avicephaliform (Figure 133) . . . . corvinus Ball

24'. Periandrium with sinistral process large, usually expanding and curving apically to the left and caudally, in form suggesting "outside" calipers; medioventral periandrial process variable, more slender and curved to the left, seldom avicephaliform (Figures 131, 137, 140) 25

25(24'). Sinistral process strongly convex between prongs of caliper and with basal prong well developed (Figure 135); anal segment in caudal view with ventral profile in form of a broad, somewhat rectangulate inverted "U" (Figure 570) . . littoralis Ball

25'. Sinistral process without strong convexity, although sometimes slightly convex with basal prong of "caliper" either present or absent (Figures 153-176); anal segment in caudal view with ventral profile fairly straight, not in form of rectangulate inverted "U" (Figures 571-573) 26

26(25'). Sinistral process elongate-platelike, introrsely uncinate distally, without basal prong or subprocess but with spicules (Figure 137); basidorsal process of periandrium nearly attaining posterior margin of aedeagal complex (Figure 138) . . . . *sylvaticus* Caldwell

26'. Sinistral process usually caliperlike, having basal prong with few exceptions, and with or without spicules; basidorsal process of periandrium extended posteriorly but distinctly failing to attain proximity of posterior margin of aedeagal complex (Figures 141, 172) 27

27(26'). Flagellum with none of its three processes unusually short and directed primarily to the left from the left caudal margin (shortest of three flagellar processes moderately small, visible dorsally but not ventrally, and directed cephalad); sinistral process with spicules, usually broadly and shallowly U-shaped with the breadth of opening usually but not always greater than depth of concavity when latter is present (Figures 153-176) . . . . *zyxus* Caldwell

27'. Flagellum with one of its three processes unusually short, arising on the left caudal margin, and directed left or left-caudad; sinistral process without spicules, usually deeply U-shaped, with the breadth of opening nearly always less than depth of concavity (Figures 139-144) . . . . *dondonius* Ball

28(5). Apex of flagellum with a conspicuous pointed process (Figure 112) . . . . *sablensis* Caldwell

28'. Apex of flagellum without a process (Figures 110, 114) 29

29(28'). Flagellum with a fairly long, slender process originating in its basiventral area and directed to the left (Figure 114); dorsal periandrial mass with dextral prong or process extending posteriorly in at least a portion of its length (Figures 115, 118) . . . . *chuliotus* Ball

29'. Flagellum without a process arising in its basiventral area (Figure 110); dorsal periandrial mass with dextral prong or process not extending caudad (Figure 111) . . . . *bispinus* Caldwell

30(4). Aedeagal complex with a conspicuous corkscrew-shaped process spiraling around flagellum; flagellum initially directed to left, then curving caudad 90 degrees; flagellum without apical processes (Figures 123, 124) . . . . *acicus* Caldwell

30'. Aedeagal complex without a large, corkscrew-shaped process spiraling around flagellum; flagellum directed left at right angle to apodeme of aedeagus; flagellum with a pair of apical processes (Figures 119-122) 31

31(30'). Venter of periandrium with a pair of similar apical processes; dorsum of periandrium with an apical retrorse process directed cephalad primarily; flagellum apically with a pair of subequal processes arising on dorsal and ventral surfaces (Figures 119, 120) . . . . complectus

31'. Venter of periandrium with a single, apical process; dorsum of periandrium without an apical process; flagellum apically with an unequal pair of processes arising in a common area on the ventral surface (Figures 121, 122) . . . . . . viequensis Caldwell

32(3). Left medioventral surface of periandrium giving rise to a moderately long acuminate process directed to the left (Figure 125); left style with caudal sublobe smoothly rounded and directed to left (Figure 265) . . . . exoptatus Van Duzee

32'. Left medioventral surface of periandrium not as above but shorter, often truncate or weakly bifid and often not directed straight left (Figures 127, 129); left style with caudal sublobe varied, produced posteriorly in some specimens (Figures 267-270) 33

33(32'). Left style with caudal sublobe produced posteriorly as a spinelike process (Figure 269); left venter of periandrium in ventral view giving rise to a semi-truncate process directed approximately 45 degrees left caudad . . . . fidus Van Duzee

33'. Left style with caudal sublobe lobelike not developing into a spinelike process (Figure 267); left venter of periandrium in ventral view usually giving rise to a short, weakly bifid process directed approximately 90 degrees to the left (Figure 127) . . . . <u>beirnei,</u> new name

34(2). Aedeagal complex with the dominant process having many spiny subprocesses (Figure 74); pygofer process subtriangular in ventral aspect, not greatly expanded (Figures 334-336) 35

34'. Aedeagal complex without any large process having many spiny subprocesses; pygofer process greatly expanded and rounded in ventral aspect (Figures 339-342) 36

35(34). Pygofer process with apex somewhat rounded and attaining, or nearly attaining, level of apices of pygofer lateral lobes (Figure 334); left basal periandrial process with apical portion straight and with distal portion of large ventral process usually curving 90 degrees near apex (Figure 74); each style with inner process having short protuberance along caudal margin (Figures 217, 218) . . . . <u>quinquelineatus</u> (Say)

35'. Pygofer process with apex acute and distinctly not attaining level of apices of pygofer lateral lobes (Figures 335, 336); left basal periandrial process with apical portion recurved slightly more than 180 degrees, and with distal portion of large ventral process making little or no curve near apex (Figure 75); each style with inner process not having short protuberance along caudal margin (Figures 219, 220) . . . . vicarius (Walker)

36(34'). Aedeagal complex with a long, very slender, lightly sclerotized (subhyaline) process arising at apex of flagellum and curving approximately 90 degrees to the left (Figures 86-89) 37

36'. Aedeagal complex without a long, very slender, apical process (Figures 81-85) 38

37(36). Aedeagal complex with two massive processes, enlarging and becoming bifid at their respective apices (Figures 86, 89); styles with apices, produced (Figures 229, 230); pygofer lateral lobes truncate in lateral aspect (Figure 399) . . . . placitus Van Duzee

37'. Aedeagal complex without two massive processes that enlarge and become bifid at their respective apices, all processes tapering to a point (Figures 87, 88); styles with apices rounded posteriorly (Figures 231, 232); pygofer lateral lobes subacute in lateral aspect (Figures 400, 401) . . . . montanus Metcalf

38(36'). Aedeagal complex with three long processes extending caudad from basal areas (Figures 84, 85); swollen part of pygofer process about as wide as long in ventral aspect (Figure 340) . . . . _eximus_ Caldwell

38'. Aedeagal complex with four long processes extending caudad from basal areas (Figures 81-83); swollen part of pygofer process longer than wide in ventral aspect (Figure 339) . . . _teximus_ Caldwell

39(1). Flagellum with basal half or third of loop having a process developing from inner margin (Figures 6, 35, 39, 42) 46

39'. Flagellum with basal half of loop not giving rise to a process from inner margin (Figures 49, 51, 56, 57, 60, 61) 40

40(39'). Venter of periandrium with the right apical area giving rise to a prominent retrorse process as in (Figures 64, 66); distal half of each style with massive lobe and stout hooklike inner process on basal margin of lobe (Figures 206-209) 41

40'. Venter of periandrium with the right apical area not giving rise to a prominent retrorse process (Figures 54, 56) distal half of each style not massive, nor with a stout hooklike inner process as above 42

41(40). Retrorse process of right apicoventral area of periandrium making approximately a 90 degree curve to the left near its distal third; periandrium with a total of five processes (Figures 66, 67); anal segment with apex distinctly concave in dorsal view, forming a pair of points (Figure 435) . . . lobatus Caldwell

41'. Retrorse process of right apicoventral area of periandrium recurved approximately 135 degrees to the right near its distal third, unciform; periandrium with a total of four processes (Figures 64, 65); anal segment with apex convex in dorsal view (Figure 434) . . . . caldwelli, new species

42(40'). Periandrium with two processes visible in ventral view, and dorsally with a retrorse process arising from the extreme right apical area at base of flagellum (Figures 60, 61). . . . . apache Ball

42'. Periandrium with three or four processes visible in ventral view and dorsally without a retrorse process arising from the extreme right apical area at base of flagellum 43

43(42'). Flagellum with two similar apical processes; dorsal periandrium with a process in the left apical area (Figures 49, 51, 56, 57) 44

43'. Flagellum with one apical process; dorsal periandrium without processes in the left apical area (Figures 55, 63) 45

44(43). Total periandrial processes five; venter of periandrium with right basal process forked and left basal process short, toothlike (Figures 49-51) . . . . knullorum, new species

44'. Total periandrial processes three; venter of periandrium with right basal process unforked and left basal area swollen, developing caudad into a long recurved process (Figures 56, 57) . . retentus Caldwell

45(43'). Periandrium with right side not tumid; dextral process broad, serrately truncate and appearing broken or malformed; left basiventral portion of periandrium developing into two slender processes, the outer approximately half the length of the inner (Figure 54); inner processes of styles asymmetrical, the right process distinctly longer than the left (Figures 194-197); anal segment moderately hoodlike, not greatly so (Figure 524) . . . canyonensis, new species

45'. Periandrium with right side tumid semibasally, dextral process slender, acute, curved to the left and dorsad, thus partially hidden in ventral view (Figure 62); left basiventral portion of periandrium developing into only one unusually long process (Figure 62); inner processes of styles nearly symmetrical, shorter and slimmer than inner process of right style of species above (Figures 204, 205); anal segment greatly hoodlike, forming deep inverted "V" in caudal view (Figure 528) . . . . papagonus Ball

46(39). Dorsal periandrium with one process (arising in apical area) (Figure 53) 48

46'. Dorsal periandrium with no process (Figures 36, 37) 47

47(46'). Styles symmetrical, slender, subterete apically; lateral expansion of each style arising at right angle to shaft, far removed from apex, slender and slightly curved (thumblike) (Figures 179, 180) . . . . hesperius Van Duzee

47'. Styles slightly asymmetrical with shafts moderately slender; lateral expansion of each style at apex, with broad expansion angularly recurved (Figures 177, 178) . . . . aridus Ball

48(46). Periandrium with basiventral area having two or three short, entire processes; left apicoventral area of periandrium with an unusually long, partly curving, twisting process directed left-cephalad (Figures 58, 59) . . . . truncatus Van Duzee

48'. Periandrium with basiventral area having less than two short, entire processes; left apicoventral area of periandrium without an unusually long, partly twisting process directed left-cephalad (Figures 40, 43, 44, 47, 52) 49

49(48'). Flagellum with five processes, including a short, pointed process directed left from base at the caudal extreme of aedeagal complex; periandrium with total of three processes, counting any forked process as one (Figures 52, 53) . . sementinus Ball

49'. Flagellum with four processes and not having a short, pointed process directed left from base at caudal extreme of aedeagus complex; periandrium with total of four or five processes, counting any forked process as one (Figures 40-48) 50

50(49'). Flagellum with inner process near middle of loop, short, stout, and with apex directed left; periandrium with total of four processes counting lateral ramus of a fork (Figures 42, 43) . . . . pima Kirkaldy

50'. Flagellum with inner process longer, more slender, apex directed right-cephalad; periandrium with total of five processes not counting lateral ramus of a fork (Figures 40, 41, 44-48) 51

51(50'). Left lateral lobe of pygofer with posterior margin having a small, thumblike projection or sublobe (Figure 370); left basiventral area of periandrium in ventral view having a small process appearing to make two 90 degree curves; dextral process of periandrium long, forked in apical one-fourth or one-fifth; periandrium without an additional dextral process (Figures 44, 45) . . . . sonoitus Ball

51'. Left lateral lobe of pygofer with posterior margin not having a small thumblike lobe or process (Figures 367, 372); left basiventral area of periandrium without a process fitting description above; basal dextral process moderately long, unforked or forked, if latter, then forked approximately one-third distance from apex; periandrium with an additional more distal dextral periandrial process (Figures 40, 46, 47) 52

52(51'). Periandrium ventrally with basal dextral process forked and with mediosubapical process short, straight, and directed right-caudad (Figure 40); styles with inner processes arising in distal third (Figures 181-183) . . . . kieferi, new species

52'. Periandrium ventrally with basal dextral process not forked and with mediosubapical process long, partially curved, and directed primarily to the left (Figures 46, 47); styles with inner processes developing at middle portion (Figures 188, 189) . . . . californicus Van Duzee

OLIARUS ECOLOGUS CALDWELL

Figures 116, 117, 257, 258, 356, 419, 459, 504, 554, 578

Oliarus ecologus Caldwell, 1947. Ohio J. Sci. 47:76.

Length of male 3.7 to 4.5 mm (based on 115 specimens); length of holotype 4.3 mm. Ground color of vertex and mesonotum piceous in most specimens, fuscous in other specimens; carinae of mesonotum varying from concolorous to partially dull orange (there is a distinct tendency for median carina to be orange), other four carinae black or dark brown. Head: Vertex narrow, length in middle line distinctly greater than width at apex of posterior emargination; median carina present in basal half. Face piceous or fuscous and with prominent carinae which are more heavily orange or yellow on the frons; maculae absent; frons wider than long in middle line. Rostrum short, failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae usually separate from pale border of posterior margin, but nearly tangential in some specimens. Mesonotum with all carinae prominent. Tegmina without large spots or bands but with suffusion around apical cross-veins; membrane usually with a slight dusky aspect, especially distally, but glossy clear in some specimens; veins predominantely pale, becoming brown apically; tubercles not prominent; apical cells usually 11 and anteapical cells 5; stigma pale yellow or brownish; length less than twice width. Legs with all tibiae usually pale yellow, with brownish overtones in some specimens.

Male terminalia: Aedeagal complex as in figures 116 and 117; pointed processes eight. Periandrium ventrally with two straight, stout, pointed processes in the median subapical area and with two more processes in the left apical area, these processes curving left, then ventrocephalad apically, the thinner and more caudal of this latter pair hyaline and easily overlooked, the other process of this pair hyaline basally, becoming sclerotized in apical half, also becoming swollen in middle portion, apex becoming abruptly acuminate; dorsal periandrium with two processes, one originating basally on right and becoming long, slender, and sinuate, with apex extending caudad of base of flagellum; other dorsal process originating in the left apical area, curving right, then caudad, stoutest in this middle portion, recurved apically, with the apex approximately pointing toward the apex of the other dorsal process. Flagellum with two slender, moderately long processes originating in the caudoapical area, one dorsal, the other ventral, the latter extrorse at its apex, the dorsal process introrse at its apex. Styles as in figures 257 and 258; symmetrical; apices broadened and evenly recurved; inner processes very short, pointed. Connective as in figure 578; long and slender with combined width of the ventral arms approximately equal to width of base of the shaft. Pygofer as in figures 356 and 419; symmetrical; medioventral process triangular in ventral aspect, broadest at base, sides nearly straight, pointed or nearly so, greatest width approximately three-fourths the length; usually extending posteriorly approximately half the distance to the level of the apices of the pygofer lateral lobes; pygofer lateral lobes evenly produced and rounded. Anal segment as in figures 459, 504, and 554; width approximately 7/10 the length in dorsal aspect; nearly symmetrical, right caudal margin slightly more produced than left side in some specimens; margin very slightly concave ventral profile in caudal aspect, slightly undulate but generally fairly straight.

In the past, Oliarus ecologus Caldwell has been misidentified most often as O. franciscanus (Stål), but it has also been confused often with O. chuliotus Caldwell, O. sablensis Caldwell, and O. humilis (Say). O. franciscanus is a South American species and very different. The aedeagal complex of O. humilis is much different from that of O. ecologus; other differences are discussed under O. humilis.

Oliarus ecologus is the only species I have seen that has a sizeable hyaline process on the aedeagal complex. This process is located on the left apex of the ventral periandrium, extends caudad, curves left and cephalad. It has been neglected in previous descriptions and illustrations. Another process, which is hyaline basally and lies adjacent to the hyaline process, is darker apically and broader, and has a shape and position I have seen only in ecologus. Other highly diagnostic processes include the sinuate right dorsal process and the thicker, more sharply curving, dorsal process that becomes the most caudal part of the aedeagal complex. This dorsal combination of processes is unique among the New World species I have examined. The two subapical processes of the flagellum are also distinctive and will immediately separate ecologus from the similar chuliotus and sablensis, which, respectively, have none and only one process in the apical region. Undissected ecologus can be distinguished from chuliotus or sablensis by observing the unhidden apical portion of the aedeagus complex in situ. O. ecologus lacks the slender, left directed, ventral process and the platelike or humplike dorsal "process" of the flagellum.

These usually can be seen in chuliotus or sablensis. The anal segment of ecologus usually extends slightly farther caudad on the right side, apparently an adaptation to accomodate the extra long dorsal process of the periandrium that curves to the right. O. chuliotus and sablensis do not have right terminus of the anal segment longer than the left. The styles of ecologus are longer. The pygofer process of ecologus is only about one-third the length of the styles, but in chuliotus or sablensis the process is about one-half the length of the styles. The pygofer process of ecologus is triangular in ventral view, with apex acute and sides straight, broadest at the base; in chuliotus or sablensis the apex is slightly rounded, the sides a little swollen, and the broadest part is not at the base but at the middle. These pygofer characteristics are best seen in specimens treated with potassium hydroxide but usually are visible in situ.

The type series of Oliarus ecologus Caldwell consists of "male holotype, female allotype, and many paratypes of both sexes from Pickaway Co., 7-1-36; paratypes same locality, 6-16-34, 7-8-36; Ross Co., 7-3-38; Jackson Co., 7-22-38; Licking Co., 6-16-34; and Lawrence, 6-24-34, all in Ohio." J. S. Caldwell was the collector.

I have discovered the following type material in the United States National Museum collection: holotype male, allotype female, and paratypes. The male from Licking County is not Oliarus ecologus but is O. sablensis Caldwell. I presume two paratypic females, having the same collection data as this male, are sablensis also. The males and presumably the females of the remainder of the type series are all ecologus.

Caldwell in his original description correctly pointed out that the genitalia drawings of "O. franciscanus" he prepared for Osborn's "The Fulgoridae of Ohio" are actually of the species Caldwell later described as O. ecologus. Also, as Caldwell pointed out, Figure C is a mirror image of the true position.

Male specimens were determined from Connecticut (Mt. Carmel), New Jersey and Pennsylvania on the northeast, south through Maryland, District of Columbia, Virginia, North Carolina (Morrow Mountain State Park and Raleigh), South Carolina (Clemson), Georgia (Griffin), Alabama (Prattsville), Mississippi (Vicksburg), and Arkansas (Marion County), north and west to Tennessee (several localities), Kentucky (Oldham County), Ohio, Illinois (Cave-in-Rock and Vienna), and Kansas (Douglas County, Lawrence, and Manhattan). I have not yet been able to confirm the occurrence of Oliarus ecologus in Canada. Beirne's records of ecologus in Canada appear to be in error, although I have not seen all the specimens listed in his Cixiidae of Canada (1950), The Mer Bleue, Ontario, record is sablensis, not ecologus, and the illustrations of ecologus in Beirne's paper are sablensis. I know of only one locality for ecologus north of the 40th parallel, and this locality is closer to the 40th than the 41st.

Oliarus ecologus Caldwell does not appear very closely related to any other Nearctic species. The O. chuliotus group probably is closest to ecologus. Further studies may confirm that ecologus Caldwell is a classic example of the Carolinian Fauna with center of origin in the southern Appalachian Mountains. The longest series of available specimens is from the Great Smoky Mountain National Park and vicinity.

The habitat labels on specimens of Oliarus ecologus Caldwell are: floodplain woods, prairie meadow, and "Lespedeza serecia" (Miq.) (= L. cuneata Don).

Dr. C. W. O'Brien collected a series of 30 male Oliarus at a location "8 miles east of Skylight, Oldham County, Kentucky." Three of these are O. sablensis and the remaining 27 are O. ecologus. Thus, these two species not only look alike, they apparently share some of the same habitats.

The known seasonal distribution of Oliarus ecologus Caldwell extends from May 5 to August 12. O. ecologus probably is a univoltine species.

OLIARUS DIFFICILIS VAN DUZEE

Figures 79, 80, 223, 224, 299, 338, 394, 395, 442, 487, 537

Oliarus difficilis Van Duzee, 1912. Bull. Buffalo Soc. nat. Sci. 10: 494-495.

Oliarus difficilis; Ball, 1934. J. Wash. Acad. Sci. 24:270-272 (Key, comparative notes).

Oliarus difficilis; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:58 (Catalog of seven references 1912-1928).

Length of male 4.5 to 5.0 mm (based on nine specimens). Ground color of vertex and mesonotum variable medium brown, mesonotal carinae concolorous. Head: Vertex moderately narrow, variable, length in middle line usually greater than width at apex of posterior emargination; median carina usually feebly developed (distinct in basal half of disc in some specimens). Face with color somewhat variable, usually castaneous or ochraceous; median carina conspicuously elevated, yellowish throughout length and with unusually conspicuous fork at base; lateral carinae pale yellow and conspicuous; maculae not present in some specimens, feebly developed in other specimens; frons moderately narrow, width greater than length in middle line. Rostrum moderately long, usually slightly surpassing posterior trochanters.

Thorax: Pronotum with intermediate carinae joining pale border of posterior margin. Mesonotum with intermediate carinae weaker, variable, almost obsolete in some specimens. Tegmina with membrane usually subhyaline, basal area smoky brown in some specimens; spots usually present at fork of Sc + R, fork of Cu_1, and on short length of M at level in line between forks just mentioned; crossveins usually with brownish suffusion; commissure fuscous basad of Y-vein juncture for approximately two-fifths length of commissure; tubercles brownish, moderately conspicuous because of contrast to pale veins; veins dingy pale yellow on most of tegmen, becoming fuscous at apex of tegmen; apical cells normally 11 and anteapical cells 6; stigma a distinct brown patch, approximately twice as long as wide. Legs mostly light brown without bands.

Male terminalia: Aedeagal complex as in figures 79 and 80; total processes seven. Periandrium with five processes; ventrally with short, stout, acuminate dextral and sinistral processes; median area giving rise to prominent process directed caudally to level of flagellum, then curving left and recurving on itself to become directed to the right, terminating at level of aedeagal joint; left subbasal area giving rise to conspicuous process directed caudally initially then making scythelike curve to the left; dorsal periandrium with very short, stout process directed to the right from left apical area of periandrium. Flagellum curved to the left and bent anteriorly in its distal half, with the apex recurved right-dorsally with two slender, prominent, fairly straight apical processes, the dorsal one longer, terminating in the median, basal area of dorsal periandrium; these two processes forming an inverted "V" when viewed from left lateral aspect. Styles as in figures 223 and 224; symmetrical or nearly so ; shaft greatly swollen, especially basally; enlarged and recurved at slightly more than 90 degree angle when viewed in broadest aspect; inner processes moderately short, broad basally, rapidly becoming acute; _in situ_ the styles stout, nearly straight and contiguous for most of length. Connective as in figure 299; unusually long and slender; combined width of ventral arms distinctly greater than width of base of shaft in posterior aspect. Pygofer as in figures 338, 394 and 395; somewhat asymmetrical; medioventral process nearly an equilateral triangle in ventral aspect, extending posteriorly less than half distance to level of apices of pygofer lateral lobes; lateral lobes in lateral aspect with left lobe slightly more produced, somewhat rounded, subtruncate; right lateral lobe narrower, subacute. Anal segment as in figures 442, 487 and 537; slightly asymmetrical in dorsal view, right side more fully developed; longer than wide; medioapical margin approximately straight; ventral profile in caudal aspect slightly concave.

Oliarus difficilis Van Duzee is an uncommon species of Neotropical affinities as yet found only in the southern half of Florida and the Lower Rio Grande Valley of the Nearactic Region. The male terminalia are highly distinctive, but the habitus resembles a few other species, such as *O. texanus* Metcalf and the *O. chuliotus* group. *O. difficilis* is usually larger than *texanus* or *chuliotus*. The vertex of *difficilis* is usually narrower than that of *texanus* or *chuliotus*; *texanus* males have the lateral lobes of the pygofer more swollen apically, a longer medioventral process of the pygofer, and styles differently shaped than in *difficilis*. There is a distinct tendency for *difficilis* to have spots in the basal half of the tegmen, with *chuliotus* lacking these spots. The intensity of spotting and dark areas in the tegmina of *difficilis* are variable.

The type material of *Oliarus difficilis* Van Duzee consists of two females taken at Belleair, Pinellas County, Florida, by Mrs.

Annie Trumbull Slosson. These specimens are in the American Museum of Natural History. I have seen the one that has a yellow paratype label on it. Since no males were involved in the original description or type series, there has been a problem which particular male form of Oliarus belongs with the difficilis females. I agree with Ball (1934) that the female specimens of the males and females he collected in central and southern Florida and at Brownsville, Texas, fit Van Duzee's description of difficilis, and the males fit Metcalf's 1923 description of O. vittatus (holotype male) from Brownsville. Metcalf's concept (1923) of O. difficilis is the species referred to below as O. teximus Caldwell. The decisions of Ball (1934) and by myself in this paper have become strengthened as the types and species concepts of the other Nearctic forms have been worked out and no conflicts have arisen that challenge our choice of males to go with the difficilis females. The male illustrated is in the Ohio State University collection and has the data "Dade Co., Fla., V-12-39 (D. J. and J. N. Knull) F. W. Mead Specimen No. XII-6641." I have placed a "Plesiotype" label on it.

The known range of Oliarus difficilis Van Duzee is quite restricted. The Texas specimens are all from Brownsville or Hidalgo County. In Florida the specimens seen by me are from Collier, Dade, Highlands, Lee, Palm Beach, Pinellas, and Seminole Counties. These counties are in central and southern Florida.

Oliarus difficilis Van Duzee is not close to other North American forms; it seems closely related to and perhaps conspecific with Vincentia christopheri Fennah (1945b), described from specimens taken at St. Kitts in the Lesser Antilles.

The Neotropical affinities of Oliarus difficilis Van Duzee are strengthened by a specimen I discovered in the undetermined material at North Carolina State University. This male is similar to Vincentia christopheri Fennah and O. difficilis Van Duzee. It is from Corumba, Mato Grosso, which is near the geographical center of South America, actually in Brazil but close to Bolivia.

Collection data on specimens of Oliarus difficilis Van Duzee include: "in pasture, S. Texas garden"; "Mimosa borealis" [Gray]; on Celtis mississippiensis [=C. laevigata Willdenow]; blacklight trap. The hosts listed for the closely related Vincentia christopheri Fennah (1945b) are: "on Coccoloba uvifera [Linnaeus] and Acacia sp."

The known seasonal distribution of Oliarus difficilis Van Duzee extends from March 4 to December 11 but without any July or September records and only one for August. The majority of the records are in spring.

OLIARUS COCONINUS BALL

Figures 106, 107, 247, 248, 312, 351, 411, 412, 454, 499, 549

Oliarus coconinus Ball, 1934. J. Wash. Acad. Sci. 24:274. 270-271, 275 (Key, comparative notes).

Length of male 3.8 to 5.3 mm (based on 37 males). Ground color of vertex and mesonotum fuscous to piceous; mesonotal carinae usually orange, sometimes brownish. Head: Vertex in middle line distinctly longer than broad at apex of posterior emargination; median carina absent or very short. Face usually fuscous, but sometimes piceous; median carina distinctly orange and traversing entire face; basal fork of median carina short, highly calloused; lateral carinae orange to pale yellow with paleness tending to broaden near epistomal suture; frons moderately narrow, wider than long in middle line with length about four-fifths to five-sixths the width. Rostrum short, failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae usually not attaining pale band of posterior margin but occasionally tangential thereto. Mesonotum with carinae of nearly equal prominence. Tegmina immacualte except for slight suffusion around apical crossveins; commissure with a brown portion immediately based union of Y-veins; tubercles moderate in size, concolorous with the veins which are a nearly uniform medium brown; normally with 11 apical and 5 anteapical cells; stigma brown, somewhat ovoid, approximately twice as long as wide. Legs brownish basally, yellowed distally.

Male terminalia: Aedeagal complex as in figures 106 and 107; total pointed processes six. Periandrium with four processes:

dextral process moderately long, straight, and stout; in ventral aspect outside margin convex, inside (left) margin very slightly concave, in either ventral or dorsal aspect not overlapping other parts of aedeagal complex, extending caudad to or near level of aedeagal joint; sinistral process nearly always shorter than dextral process, widest at base, extending nearly straight caudad, occasionally curved at extreme apical area; the dextral and sinistral processes parallel to each other; periandrium with the one strictly ventral process conspicuous and originating in the median apical area, extending caudad initially then curving to left and falciform in appearance; dorsal periandrium with one process, inserted mediobasad, variable in shape and size, but usually stout, tending to be swollen in the middle, generally extending fairly straight caudad, apex straight or curved as much as 90 degrees to the left; shape of dorsal process in some specimens spathulate, particularly suggesting asymmetrical spathe (elongate-ovoid with incurved summit) of skunk cabbage, _Symplocarpus foetidus_ (Linnaeus) Nuttal. Flagellum generally extending to the left and with two processes; apex of flagellum with a prominent, stout, acuminate process which usually is directed primarily anteriorly, but in some specimens directed at various angles posteriorly or to the left; a second flagellar process originating at posteriormost portion of complex, then extending along curvature of flagellum to the left and cephalad, the apical portion on some specimens concealed in ventral view, this process linear, finely tapered in apical portion; basidorsal cephalic side of flagellum spiculate, the sinistral process of periandrium usually ending a short distance from the spiculate area. Styles as in figures 247 and 248; symmetrical; apex enlarged and evenly rounded, generally orbicular in broadest apex; in situ, with inner margins notched near medioventral process of pygofer; inner processes short, pointed. Connective as in figure 312; rather slender and slightly twisted; combined width of ventral arms slightly exceeding width of base of shaft in posterior aspect. Pygofer as figures 351, 411, and 412; medioventral process in ventral view triangulate, slightly longer than wide, broadest at base; short, the length slightly less than half the distance to level of apices of pygofer lateral lobes; lateral lobes moderately produced, in ventral aspect diverging at relatively wide angle; lobes nearly symmetrical, apices rounded or slightly pointed in lateral aspect with the apices considerably ventrad of midlength of posterior margin. Anal segment as in figures 454, 499, and 549; in dorsal aspect almost as wide as long; symmetrical; outline pyriform; medioapical area with a short, acute convexity on each side of a smoothly curved concavity; in caudal view, the ventroapical margin strongly concave from side to side, the complete profile of the anal segment approximately lunate.

Oliarus coconinus Ball is a fairly common southwestern species that is superficially similar to numerous other species but is quite distinct from the standpoint of male terminalia. I have seen no other species close to it, but there is considerable infraspecific variation. The very broad anal segment with the twin apical points is diagnostic; the well developed and parallel dextral and sinistral processes are distinctive; the apical process of the flagellum, having a slight extrorse curve instead of the usual introrse curve, is diagnostic, and the group of spicules on the basidorsal part of the flagellum is something I have seen in no other species. High magnification and proper lighting are needed to see these spicules clearly.

Some of the variability has already been noted. Perhaps the most atypical specimen discovered was collected at 15 kilometers east of Sombrerete, Zacatecas, Mexico, on "28-30 VII-1951," by P. D. Hurd. In it the sinistral process of the periandrium is slightly longer than the dextral process instead of the usual form where the sinistral process is distinctly shorter. The dorsal process of the periandrium is reduced to a rather short, acuminate process. The apical process of the flagellum is directed right-caudad, an atypical direction.

The types as listed by Ball consist of: "Holotype female, allotype male, and one male paratype Williams July 13, 1929, a female Aug. 15, 1929, a female Flagstaff Aug. 7, 1929, and two males . Huachuca Mts., Aug. 2, 1931, all taken by the writer [E. D. Ball] from the table lands or mountains in Arizona." I have seen all the types in the United States National Museum with the possible exception of the two male Huachuca Mountain paratypes. Concerning the latter, a pair of Oliarus coconinus males is mounted on one point and the pin has the precise label information as provided in the original description, but there is no blue paratype label as commonly provided on Ball's paratypes. I consider these two males as unmarked paratypes.

The holotype female was on the same paper point as the allotype male and a paratype male. The holotype is next to the pin. The male on the tip had been dissected by an earlier worker, and I have used this specimen for nearly all the present drawings. These males were removed from the original point and remounted. The male originally in the middle of the point was assigned F. W. Mead Specimen Number IX-66512. Males of *Oliarus coconinus* were determined from other areas as follows: MEXICO: Morelos: Yautepec; Nayarit: Tepic; Temescaltepec: Real de Arriba and Tejupilco; Zacatecas: 15 kilometers east of Sombrete; UNITED STATES: Arizona: Coconino, Navajo, Pima, and Santa Cruz Counties; Colorado: Ft. Collins, Larimer County; Nevada: Dixie National Forest, Lincoln County; Texas: Brewster and Jeff Davis Counties; Utah: Mantua, Cache County.

The range of *Oliarus coconinus* Ball is rather widespread in southwestern North America but is disjunct. *O. coconinus* occurs from northern Utah to southern Mexico and from north central Colorado and west Texas on the east to eastern Nevada on the west. The Mexican records are considerably south of the nearest records in the United States. It is unknown whether the lack of records for California, New Mexico, several Arizona counties, northern Mexico, and other southwestern areas reflects true distribution or whether this is mostly a matter of insufficient collecting.

Although *Oliarus coconinus* Ball is a distinctive species, certain features of the male terminalia suggest that it is related to *O. humilis* (Say) in North America, and to the *O. dimidiatus* Berg complex in Central and South America.

The specimens of *Oliarus coconinus* examined by me have been without host or habitat labels. The locality labels all support Ball's contention that it is a species of tablelands and mountains. The

Mexican localities all seem to be in mountainous country. The highest altitude given on any of the labels is 8300 feet (above Onion Saddle in the Chiricahua Mountains of southeastern Arizona and collected September 6, 1965, by Lois and Charles W. O'Brien). This also is the latest seasonal record I have seen.

OLIARUS CATUS CALDWELL

Figures 108, 109, 249, 250, 313, 352, 413, 455, 500, 550

Oliarus catus Caldwell, 1947. Pan-Pac. Ent. 23:147-148.

Length of male 4.5 to 5.2 mm (based on three males); holotype 5.2 mm. Ground color of vertex and mesonotum fuscous; mesonotal carinae varying from medium brown to orange. Head: Vertex moderately broad, length in middle line about equal to width at apex of posterior emargination; median carina absent. Face entirely fuscous except carinae which are yellowish orange to dull orange; median carina with basal fork short and broad, percurrent distally; all carinae unusually prominent; frons distinctly broader than long in middle line, the length usually three-fourths the width; rostrum almost or barely attaining caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae not reaching pale band of posterior margin, usually separated by dark pigment. Mesonotum with carinae equally prominent. Tegmina with spotting confined to small areas around apical crossveins; tubercles moderate in size, concolorous or nearly so; veins nearly uniform brown, and with commissure entirely brown basad of Y-vein juncture; apical cells varying from 9 to 11 in three specimens examined, anteapical cells 5 to 6 in same individuals, holotype 11 and 6 respectively; stigma dark brown, length two to two and one-half times width. Legs mostly brownish, without banded pattern.

Male terminalia: Aedeagal complex as in figures 108 and 109; pointed processes usually seven, sometimes six or eight, depending on variation and interpretation. Periandrium usually with five processes; the dextral process primarily on ventral surface, reaching to joint of aedeagus, swollen in middle portion, acuminate apically and curving right-caudad, unforked in holotype and available specimens from Huachucha Mountains, Arizona, but with short, slender, pointed fork at midlength of right margin in specimen from Tumicacori Mountains, Arizona; sinistral process nearly obsolete, reduced to short, slender, acuminate process directed ventrad primarily; a large falcate process originating in left-median basiventral area, directed caudad initially, expanding considerably in middle portion, curving to left and becoming acute at apex, somewhat sinuous basally, and with inner, left margin twice repand in holotype but regular in other two specimens available for study; dorsal periandrium giving rise to a long, slender process originating apically, directed left cephalad for much of length, gradually curving ventrad and caudad; median basidorsal area of holotype with small, slender process, obsolete or nearly so in other specimens examined. Flagellum directed left, then curving cephalad distally; with a medium-sized subapical process originating on dorsal side and primarily directed dorsocephalad; a second slender flagellar process along caudal margin, originating subbasally, directed left primarily, with apex curving partially dorsad. Styles as in figures 249 and 250; slender, nearly symmetrical, moderately long, apically broadened and considerably recurved; inner processes short, pointed. Connective as in figure 313; moderately long and slender; combined ventral arms slightly wider than base of shaft in posterior aspect. Pygofer as in figures 352 and 413, bilaterally symmetrical or nearly so; medioventral process in ventral aspect moderate in size, sides nearly parallel in basal half, apex bluntly pointed, width two-thirds to three-fourths the length, the length slightly less than half the distance to tips of pygofer lateral lobes; lateral lobes well produced posteriorly, apices in lateral aspect varying from semi-rounded to acute and most strongly produced well ventrad of midlength of posterior margin. Anal segment as in figures 455, 500 and 550; distinctly longer than wide, the width three-fourths to four-fifths the length in dorsal view; apical medioventral margin truncate to convex in dorsal aspect, straight to slightly concave in caudal aspect.

Oliarus catus Caldwell is easily diagnosed by examination of the aedeagal complex. Otherwise it resembles several of the medium-sized, brownish species of the southwestern United States. The distinctive characteristics include the aborted sinistral process, the two large, diverging, centrally swollen processes of the ventral side, the long, curving, somewhat retrorse apical process of the dorsal periandrium, and the position of the two flagellar processes. I have seen no other species close to catus in these respects, although corvinus Ball, for example, is close in general appearance.

Oliarus catus Caldwell seems to stand apart from other known species in the United States but may be closest to O. humilis (Say). In Central and South America the closest forms I have seen among the limited number examined are in the O. dimidiatus Berg group. Both humilis and dimidiatus match or nearly match O. catus process for process within the aedeagal complex, the differences occurring primarily in the shapes of the processes.

The three male specimens available for study exhibit minor variations in all features that I have examined. Not previously mentioned is the variation of vein M in the tegmen. It has three branches reaching the apex in one individual, four branches in another, and five in the holotype.

The holotype male was collected in Carr Canyon, Huachuca Mountains, Arizona, June 23, 1932 by J. O. Martin. The allotype female was collected at Cave Creek, Chiracahua Mountains [Cochise County], Arizona, June 20, 1932 by J. O. Martin. These specimens are in the California Academy of Sciences collection and were examined by me, the holotype serving for most of the illustrations. Other specimens examined consist of a male from the Huachucha Mountains, Arizona, September 9, 1938, (D. J. and J. N. Knull), Ohio State University collection; and a male from the Tumicacori Mountains [Santa Cruz County], July 22, 1938 (R. H. Beamer), University of Kansas collection. Thus the known range of *Oliarus catus* Caldwell is restricted to two counties in the southeastern corner area of Arizona; the earliest date of collection is June 20, the latest September 9.

OLIARUS HUMILIS (SAY)

Figures 77, 78, 221, 222, 298, 337, 393, 441, 486, 536

Flata humilis Say, 1830. J. Acad. nat. Sci. Philad. 6:24.

Oliarus humilis; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2: 67-68 (Complete bibliography).

Oliarus humilis; Osborn, 1938. Ohio biol. Surv. Bull. 6:299-302 (Key, illustrations, distributional notes).

Oliarus humilis; Beirne, 1950. Can. Ent. 82:93-94 (Key, distribution).

Length of male 4.1 to 5.0 mm (based on 80 specimens). Ground color of vertex and mesonotum dark brown or black; mesonotal carinae concolorous. Head: Vertex width variable but usually appearing broad and diverging basally, shorter in middle line than broad at apex of posterior emargination; median carina absent or very short. Face entirely fuscous except carinae varying from brown to dull orange; basal fork of median carina somewhat variable, usually broad as long; frons wide as long to 1.6 times wider than long in middle line. Rostrum with length variable, usually not attaining caudal margins of posterior trochanters but sometimes slightly exceeding them.

Thorax: Pronotum with intermediate carinae not attaining pale band of posterior margin. Mesonotum with carinae uniformly conspicuous. Tegmina without spots, but membrane fumose with light to dark brown on apical third, usually fairly dark; basal portion of tegmen usually but not always lighter, in some specimens nearly clear, in others almost concolorous with apical portion; veins fairly uniform brown; tubercles not conspicuous; usually with 11 apical and 5 anteapical cells; stigma brown, short, and broad. Legs generally brownish.

Male terminalia: Aedeagal complex as in figures 77 and 78; total pointed processes six. Periandrium with four processes; the dextral process appearing fairly straight and slender in ventral view but arcuate in lateral aspect, tip curving ventrad; sinistral process longer and reflexed subapically, the apical portion directed left-ventrocephalad; median basiventral process long, slender, scythelike, usually directed caudad, then curving to the left in ventral aspect; dorsal process originating mediobasally, directed caudad, gently sinuate, long, slender, and pointed, approximately reaching apex of complex. Flagellum with two processes, a slender one in the apical region directed cephalad and only partially visible in ventral aspect, the second process basidorsal, short, stout, directed to the left. Styles as in figures 221 and 222, rather stout, swollen basally, rounded and recurved apically; inner processes short, pointed, nearly symmetrical. Connective as in figure 298; moderately long and slender; combined ventral arms distinctly wider than base of shaft. Pygofer as in figures 337 and 393; medioventral process triangular, broadest at base, slightly longer than wide, extending posteriorly half or slightly less than half as far as left lateral lobe in ventral aspect; lobes well produced, nearly symmetrical, somewhat variable in degree of convexity at apices, diverging distally in ventral aspect, and in lateral aspect most strongly produced slightly below midlength of posterior margin; apodemes weakly developed. Anal segment as in figures 441, 486, and 536; in dorsal view nearly symmetrical, slightly broader on left side; longer than wide; apical medioventral margin truncate to slightly concave in dorsal view, concave and moderately hoodlike in caudal profile.

Oliarus humilis (Say) is one of the most distinctive North American species. Characters of the male terminalia, especially the aedeagal complex, are amply diagnostic for *humilis*. Additionally, *humilis* usually can be identified in either sex by the brownish apical third of the tegmen which contrasts with the paler basal portion; however, sometimes there is variation in the degree and contrast of brownish suffusion in the tegmina that leads to confusion with a few other species. In these instances the dark carinae and tablet of the mesonotum, the dark vertex, face, and frontal carinae of *humilis* are usually sufficient to separate it from other Nearctic species. Occasional dark specimens might be confused with the partially sympatric *cinnamomeus* Provancher, but the latter is larger (over 5.5 mm compared to 5.0 mm or less for *humilis* males) and has 8 to 11 apical spurs on the first tarsite of each metatarsus, compared to 7 for *humilis*. Also, the stigma and costal margin are pale in *cinnamomeus*, brown in *humilis*. The other routinely dark species in the Nearctic region is *arizonensis*, new species, apparently endemic to Arizona. It is in the size range of *humilis* but can be separated from an atypical, uniformly brown *humilis* by its larger tubercles on the tegminal veins, narrower vertex, especially at the laterobasal angles, weaker intermediate carinae of the mesonotum, and tendency of some of the head and mesonotal carinae to be lighter. Several other species have been confused with *humilis*; for example, numerous specimens taken from *humilis* unit trays in major American museums have turned out to be *ecologus* Caldwell, *sablensis* Caldwell, and *chuliotus* Ball. These species have darker apical tegminal veins and sometimes a certain amount of suffused brown on the membrane which resembles some of the lighter, more evenly suffused specimens of humilis. In both the chuliotus group and ecologus, the vertex is narrower and with subparallel lateral margins, but in humilis the vertex is broader and tends to diverge basally. O. humilis also has the vertex with broader lateral foveae.

The type of O. humilis (Say) is assumed to be lost with other Say material.

The original description fits several species; therefore, my concept of humilis follows that of Van Duzee (1908, 1923), Metcalf (1923), Osborn (1938) and Beirne (1950). The specimen used for illustrations belongs to the United States National Museum and is from Pennsylvania, the only state mentioned in the original description. It bears F. W. Mead Specimen No. label XI-16671.

The closest relative of Oliarus humilis (Say) known to me is O. dimidiatus Berg, a South American species. I have seen the type series of dimidiatus and a number of undetermined South American specimens which might be called the dimidiatus complex or group. The range of these forms includes Argentina, Brazil, and Guatemala. O. dimidiatus resembles humilis not only in the male genitalia but in the characteristic brown apical third of the tegmen.

Oliarus humilis ranges from coast to coast in a broad belt including most of the northern half of the United States and southern Canada. Southernmost record: Albuquerque, New Mexico. Specimens were examined from Quebec, Ontario, Saskatchewan, and British Columbia in Canada. In the U. S., specimens were examined from New Hampshire (Durham), Massachusetts (Woods Hole), Connecticut, New York, New Jersey, and Pennsylvania westward to Ohio, Michigan, Illinois, Wisconsin, Iowa, Minnesota, "Dacota," Kansas, Arizona (Flagstaff), New Mexico, Utah (Ephraim), Nevada (Humboldt and Lyon Counties), Montana, and Oregon (Corvallis and Salem).

Oliarus humilis is the most common northern species of the genus in North America. Little has been published about its habitats and even some of that is based on erroneous determinations. The Swezey catalogue (1904) lists "Food-plants -- Timothy and other grasses, dry pastures, meadows." There is little doubt that species other than *humilis* were involved, so this statement should be regarded as only partially correct. The study by Hendrickson (1930) on the insect fauna of Iowa prairies lists *humilis.* I have examined two males and two females in the Iowa State University collection having *humilis* determination labels and data matching that listed by Hendrickson for *humilis*. The males are *sablensis* and it is assumed the females are the same. On the other hand, the specimens determined as *complectus* are actually *humilis.* Thus the following data apply to *humilis.* "At *Andropogon furcatus* - *Sorghastrum Michauxiana* associes, 2.5 mi. south of Ames, July 15, 1926, and Aug. 4, 1927, two specimens." Although no habitat data are mentioned for *humilis* by Dozier (1928), it is well to mention the Mississippi records for *humilis* are incorrect. The Mississippi specimens, upon which his records are based, are in the Ohio State University collection. These are not *humilis*. A male with the Tupelo, Mississippi, collection data is

O. chuliotus Ball. The primary source of habitat data for humilis is the Illinois Natural History Survey collection. The following data are all from Illinois locations: low pasture, tamarack bog, on juniper, on prairie, cat-tail bog, along river, on rye, swamp, at light, and Poa pratensis Linnaeus. Elsewhere the following data are available: on hickory [Carya], on Asimina in Ohio; on alfalfa [Medicago sativa Linnaeus] at Wheatly, Ontario, and in Dane and Brown Counties, Wisconsin; at fish hatchery, sand areas in Le Sueur, Nicollet, and Scott Counties, Minnesota. These data show that humilis predominates in damp habitats of cooler climates. The seasonal distribution of adult captures among all the states and provinces is primarily in July and August, but the earliest date is June 20 (Ill.). A few September dates show the 12th (Darke Co., Ohio) as the latest; thus, the October 16, 1915, Berea, Ohio record (Osborn 1938) seems questionable; however, the specimen in the Ohio State collection with this data is correctly determined as humilis.

OLIARUS SLOSSONAE VAN DUZEE

Figures 72, 73, 215, 216, 295, 333, 390, 438, 483, 533

Oliarus hyalinus Van Duzee, 1908. Proc. Acad. nat. Sci., Philad. 1907:487 (Key 485). Preoccupied name.

Oliarus slossoni Van Duzee, 1912. Bull. Buffalo Soc. nat. Sci. 10:494. New name for Oliarus hyalinus Van Duzee (not Fieber).

Oliarus slossoni; Ball, 1934. J. Wash. Acad. Sci. 24:271 (Key).

Oliarus slossoni; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:102 (Catalog of eight references 1908-1928).

Oliarus borinquensis Caldwell, 1952. J. Agric. Univ. P. Rico 34: 137-138. New synonymy.

Length of male 6.1 to 7.4 mm (based on 31 specimens). Ground color of vertex fuscous; mesonotum lighter, castaneous to yellow-brown; carinae of mesonotum usually concolorous. Head: Vertex unusually narrow, length in middle line substantially greater than width at apex of posterior emargination; median carina variable, usually present in basal half. Face variable in color from fuscous to yellowish brown, clypeus usually darker than frons, with pair of large maculae at lateral margins of epistomal suture, usually with most of the pale area in the frons; median carina broadly prominent, but little elevated, basal fork confluent, usually nearly obsolete. Rostrum unusually long, typically surpassing caudal margin of posterior trochanters by one-half to three-fifths the length of its terminal segment.

Thorax: Pronotum with intermediate carinae either joining with or tangential to pale border of posterior margin. Mesonotum with all carinae weak, especially the anterior portion of the intermediate pair which are sometimes obsolete or nearly so. Tegmina vitreous in some specimens, milky subhyaline in others, usually darker along most of commissure, slightly infuscated at apical crossveins, and some specimens with transverse dark band at base of clavus and extending slightly into corium; tubercles weakly developed, veins variable in color, mostly pale yellow basal half, brown apical half; apical cells normally 12 and anteapical cells 6; stigma a distinct brown patch, its length approximately two and one-half times width. Legs with femora and tibiae usually pale yellow, varying somewhat to yellowish brown.

Male terminalia: Aedeagal complex nearly as in figures 72 and 73; (the two processes appearing to be attached to the base of the flagellum actually belong to the periandrium); total pointed processes eight, one of which on the dorsoapical flagellum is very short in some specimens. Periandrium with five processes, one of which is dorsal; in ventral aspect with two long, slender, slightly curved processes originating basally and subbasally on the right side; left side without a basal process but with a conspicuous subapical process directed primarily to the left; extreme apical area adjacent base of flagellum with a short, slender process directed primarily to the left; dorsal periandrium with a prominent retrorse process arising apically, initially directed cephalad, distally curving right-cephalad. Flagellum initially directed left, then making a 90 degree curve cephalad, becoming enlarged apically; with three processes in the apical region, length of processes variable but usually with the shortest closely appressed to the subapical dorsal area of the flagellum, in some specimens barely emerging from the flagellar tissue, longer and more conspicuous in other specimens; apex (with rare exceptions) either with a pair of processes of equal length or with one approximately twice as long as the other (see below). Styles as figures 215 and 216; with small apodemes, shafts swollen basally, narrowed at midlength, greatly expanded apically, angulately recurved but apex of recurved portion broadly rounded; inner processes conspicuously asymmetrical, with left inner process long, lobelike, reaching or slightly surpassing margin or recurved portion, slender, tending to be clavate; right inner process very short, not lobelike. Connective as in figure 295; moderately long and stout; combined width of ventral arms distinctly greater than width of base of shaft in posterior aspect. Pygofer as in figures 333 and 390; symmetrical or nearly so; medioventral process in ventral aspect unusually small and with two distinct widths, basally pedestallike and approximately twice as broad as the longer, cylindrical, distal portion; total length of process substantially less than one-half distance to apices of pygofer lateral lobes; lateral lobes in lateral aspect well produced, rounded. Anal segment as in figures 438, 483, and 533; slightly asymmetrical in dorsal aspect, longer than wide, medioapical margin straight or slightly concave; in caudal aspect hoodlike, middle portion of ventral profile nearly straight.

Oliarus slossonae Van Duzee is a Neotropical species found only in southern Florida in the United States. In general appearance its large size, weak mesonotal carinae, and coloration are somewhat similar to O. aridus Ball, with which it has been confused by some authorities. The male terminalia are sufficiently diagnostic to separate slossonae from aridus or any other Nearctic species, including O. difficilis Van Duzee, another species that has been confused with slossonae by some workers. Van Duzee (1912) made excellent comparisons between these species. Perhaps the best diagnostic character for either sex of slossonae is the unusually narrow, troughlike disc of the vertex, which is nearly always definitive, especially in conjunction with large overall size. Males can be diagnosed immediately by by the very small, narrow, terete medioventral pygofer process which is inserted on a pedestal. The illustration, locality records, hosts, and other comments by Dozier (1928) for slossonae in Mississippi and Texas are in error and actually refer to aridus Ball.

The most puzzling variation in males of Oliarus slossonae Van Duzee has been between the apical processes of the flagellum. It is common to find specimens with a pair of long, slender processes of equal or nearly equal length, with the outer process nearly always thicker than the inner one. It also is common to find specimens with the more slender, inner process about half the length of the outer process. Examination of many south Florida specimens showed no geographic correlation for this difference; however, the following facts are relevant. Under high magnification the shorter member of the pair does not taper to a point but remains something like the open end of a pipe, or more precisely, the end of a slightly tapered pipette. Also, in specimens where both processes are long, the thin one is slightly constricted at that point in its length which corresponds to the end of the process in the other form. I have come to the tentative conclusion that this thin process is structurally weak at this constricted part of the process, and that the process may break off at this point. If so, this would readily explain the shorter process abruptly terminating at the same relative position in the specimens having this condition; also with the apex of the short process being approximately round in end view instead of pointed. Possibly the process breaks when specimens are roughly handled in the collecting process, but it may be that this process breaks during copulation and that a short process means a male has mated and a long process that he has not.

The type of Oliarus slossonae Van Duzee is a male taken by Mrs. Annie Trumbull Slosson at Biscayne Bay, Dade County, Florida. This type is at the American Museum of Natural History. Dr. Lois B. O'Brien compared the type with a Coral Gables, Dade County, Florida, specimen which I believe to be conspecific with numerous examples from southern Florida and the Greater Antilles. Dr. O'Brien noted minor differences but agreed that the Coral Gables specimen was conspecific with the type from Key Biscayne, Florida.

Specimens examined range in the three counties of the southern tip area of Florida (Collier, Dade, and Monroe Counties, including the Florida Keys); Perico and Central Mercedes, Matanzas Province, Cuba; Camaguay, Camaguay Province, Cuba; Puerto Rico; and St. Thomas, Virgin Islands.

Caldwell in Caldwell and Martorell (1952) described Oliarus borinquensis from Puerto Rico. I have examined a male paratype of borinquensis belonging to the American Museum of Natural History and the male holotype located in the United States National Museum. I believe Oliarus borinquensis Caldwell is conspecific with Oliarus slossonae Van Duzee.

Habitat or host labels on specimens of Oliarus slossonae Van Duzee include century plant at St. Thomas, Virgin Islands; on red mangrove, Rhizophora mangle Linnaeus (in Puerto Rico); in Guanica Insular Forest in Puerto Rico; taken on Tabebuia in Cuba; in light trap; Trema micranthus (L.) Blume; at blooms of Sabal etonia Swingle; in Steiner trap; blacklight trap, on calamondin [Citrus mitis Blanco]; Steiner trap in mango tree, on Lucuma roxburgii; on Flaveria linearis Lagasca, all in Florida.

Specimens of Oliarus slossonae Van Duzee have been collected every month of the year in Florida.

OLIARUS ALTANUS BALL

Figures 102, 103, 104, 105, 245, 246, 311, 350, 409, 453, 498, 511

Oliarus altanus Ball, 1934. J. Wash. Acad. Sci. 24(6):276 (Key 271).

Length of male 4.7 mm (based on three males of type series). Ground color of vertex and mesonotum fuscous; mesonotal carinae concolorous. Head: Vertex fairly narrow, with length in middle line distinctly greater than width at apex of posterior emargination; median carina absent or nearly so. Face fuscous; median and lateral carinae strongly elevated on frons, less so on clypeus; median carina yellowish on frons except brown at basal fork; fork indistinct; lateral carinae broadly stramineous at widest portion of frons, color narrowing and becoming brownish basally; carinae of postclypeus dull orange to fuscous; face without maculae; frons narrow, length in middle line approximately three-fourths the width. Rostrum not attaining caudal margins of posterior trochanters.

Thorax: Pronotum with intermediate carinae not joining pale band of posterior margin. Mesonotum with carinae weakly to moderately prominent, intermediate pair little, if at all, weaker than the other three carinae.

Tegmina nearly immaculate, usually with small, indistinct brown spot at fork of Cu_1 and with slight embrowning around apical crossveins; tubercles prominent and abundant, usually a contrasting light brown against pale veins on basal half of tegmen, concolorous brown apically; costa entirely pale; apical margin of tegmen pale instead of usual brownish color of most other species of *Oliarus*; commissure with short brownish portion immediately basad of union with Y-veins;

forking of veins near apex variable, apical cells usually 9 or 10 and anteapical cells 6; stigma white, long and narrow, length four to four and one-half times the width. Wings with R not forked, M with one fork (only two branches reaching apex instead of usual three of most species of Oliarus). Legs with femora fuscous, tibiae mostly pale, apices of tarsi brown.

Male terminalia: Aedeagal complex as in figures 102-105; total pointed processes fundamentally only three but subject to variation and interpretation. Periandrium with two conspicuous processes, one of which becomes lobed or forked; no dorsal processes and no dextral or sinistral process in usual basilateral areas; a left process arising from broad base in midregion and extending some distance straight left, forked near apex in two specimens, but in third specimen distinctly asymmetrical, with apex divided into a broad lobe and an acuminate process; ventral left apical area giving rise to prominent retrorse process which is directed ventrad for a short distance before curving cephalad for most its length. Flagellum extending left and curving somewhat cephalad distally; with single, slender, apical process directed cephalad; ventrocaudal portion of flagellum having several spicules (difficult to see at low to medium power of stereoscopic microscope). Styles as in figures 245 and 246; asymmetrical; left style with unusual accuminate tooth or process originating on inner face near apex of recurved portion and extending beyond this apex; right style not having this special process; inner processes symmetrical, weakly developed, ridgelike, terminating abruptly with 90 degree return to expanded apex of shaft; basal portion of shaft swollen. Connective as in figure 311; shaft comparatively short and stout; combined width of ventral arms a little wider than base of shaft in posterior aspect. Pygofer as in figures 30, 350 and 409; medioventral process in ventral aspect triangular, broadest at base (not constricted near union), its apex bluntly pointed, its length slightly greater than width (ratio width to length 8.0-8.8:10), extending posteriorly slightly more than half the distance to level of apices of pygofer lateral lobes; lateral lobes of pygofer in ventral aspect with main axis of each lobe directed nearly straight caudad; lobes in lateral aspect well produced, comparatively slender and pointed, each with another lobe developing below midlength of posterior margin and directed ventrocaudad at approximate 45 degree angle. Anal segment as in figures 453, 498, and 511; in dorsal view rather long, with width but little more than half the length (5.6:10); fairly symmetrical, left side somewhat more expanded than right side; moderately concave at medioapical margin, apex ending in pair of sublateral protuberances; in caudal view, ventral profile conspicuously concave.

Oliarus altanus Ball apparently is one of the rarest species in the Nearctic fauna. It is known only from the type series of four specimens, all in the same lot, from Tinajas Altas, Arizona. It is a distinctive species easily diagnosed from the male genitalia and the tegmina. In general appearance it superficially resembles any of several other moderate-sized southwestern species of *Oliarus*. Close inspection reveals the highly unusual whitish stigma, costa, and apical border of tegmen contrasted to the brown veins in the apical half of the tegmen. In all the material seen by me, no other species has this color combination. The male terminalia are very unusual in several ways. The unusual toothlike process on the left style (absent on right style) is diagnostic; the very low number of processes (three, or four if fork is counted) is diagnostic; the presence of spicules on the left ventrocaudal part of the flagellum is highly unusual. There are no right-lateral or dorsal processes of any kind. The most diagnostic process is the broadly based process extending left from the left ventromedian area of the periandrium. It tapers somewhat, then bifurcates apically into similar subprocesses (figure 102) or ends in one pointed process and a broad lobe (figure 105). The wing veins are unusally pale in altanus and are reduced in apical branching.

Variations in addition to those cited above include additional tiny toothlike processes on the median ventral periandrium. The paratype-allotype having F. W. Mead No. VIII-17652 label has these tiny processes (figure 105) and also has a longer apical process on the flagellum. The paratype-allotype with F. W. Mead No. VIII-17651 label is more broadly bifurcate (shown in figure 103).

The holotype female, allotype male and two paratype males are located in the United States National Museum. I have examined all four. All three males were glued to one point and no reference was found as to which one was the allotype. In the process of dissecting the male genitalia, the specimens came loose, and were remounted on three separate points. The specimen originally in the middle retains the original label of "Tinajas Altas, Ar., 3-19-32, E. P. Ball" and the original allotype label. The label F. W. Mead Specimen No. VIII-16651 has been placed on this pin.

It is very difficult to place *Oliarus altanus* Ball. Possibly it is closest to *O. pygmaeus* Ball, another Arizona species. *O. pygmaeus* has more and differently shaped processes but does agree with *O. altanus* in lacking the basal sinistral and dextral processes. Furthermore, the pygofer is similar in appearance, especially in the shape of the lateral lobes. The anal segment is similar in having the deep median concavity of the caudoventral profile.

The type locality of Tinajas Altas, Arizona, has been neglected by collectors more than many other parts of Arizona. According to Torre-Bueno (1937), Tinajas Altas is in Yuma County close to the Mexican border, longitude 114 degrees W.; altitude 1000 to 1700 feet. Dr. Ball was the only one listed as a collector for the Tinajas Altas area. An outdated highway map shows "Tinajas Altas Spring" near the end of a dirt road in the Lechuguille Desert, east of the Tinajas Altas Mountains.

OLIARUS ARIZONENSIS, NEW SPECIES

Figures 98, 99, 241, 242, 309, 347, 348, 406, 451, 496, 546

Length of male 3.3 to 4.0 mm (based on 31 specimens); holotype male 3.5 mm. Ground color of vertex and mesonotum fuscous; mesonotal carinae with intermediate pair usually concolorous, median carina orange, and lateral carinae mostly dull orange. Holotype head: Vertex moderately narrow, in middle line longer than broad at apex of posterior emargination (1.4:1); median longitudinal carina short; foveae moderately broad, length two and one-half to three times the width; apical cell narrow, not prominent; frontal carina dull orange, arcuate, and indistinct at midlength. Face fuscocastaneous; median carina with basal fork short, broader than long, without distinct pit, carina percurrent, bright orange in color on frons, nearly concolorous with most of clypeus; lateral carinae distinct pale yellow or orange-yellow bordering frons and postclypeus; frons wider than long in middle line (1.28:1); combined length of frons and postclypeus one and seven-tenths times width of frons; without maculae; rostrum short, distinctly failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae not joining pale band of posterior margin, nor becoming joined laterally by longitudinal carina in vicinity of tegula. Tegula generally pale, slightly brownish in middle area. Mesonotum with carinae prominent, intermediate pair weaker, arcuate, becoming obsolete anteriorly. Tegmina evenly smoky brown, no spots or bands; veins uniformly brown; tubercles brownish, unusually large and abundant, giving rise to prominent pale setae; left tegmen with 10 apical and 6 anteapical cells, right tegmen with 11 apical and 6 anteapical cells; stigma not prominent, nearly concolorous brown, length approximately two and one-half times the width. Wings light smoky brown; left wing with triangles formed by apical forks of R and M about equal; right wing with triangle of M longer than triangle of R. Legs with only two lateral spines on each posterior tibia.

Male terminalia: Aedeagal complex as in figures 98 and 99; total pointed processes four. Periandrium with three processes: dextral process originating in a right laterodorsal position, extending caudad, then smoothly curving left-dorsad; sinistral process developing into a broad, irregularly serrate, globose-platformlike or anvillike process; ventral left-median area of periandrium with long, fairly stout process directed caudad initially, curving to left and becoming slender apically, ending in fine point.

Flagellum directed left, expanding into a rounded, sclerotized, platelike structure in ventral aspect; apical area with a moderately small, slender process directed cephalad primarily; this process with its apex barely hidden by flagellum when viewed ventrally. Styles as in figures 241 and 242; nearly symmetrical; apex of each style curved 90 degrees from main axis of shaft, the apex of recurved portion bifid, the caudal branch of the fork slender and acuminate; the cephalic branch of the fork broader, irregularly lobate; inner processes short, pointed; each shaft broadest at mid-length, generally a little broader in basal half. Connective as in figure 309; rather short and slender; combined ventral arms same width as base of shaft in posterior aspect. Pygofer as in figures 347, 348, and 406; medioventral process comparatively large, its width in ventral aspect approximately seven-tenths the length, broadest subbasally, generally triangular in outline, extending posteriorly almost to level of apices of pygofer lateral lobes; in lateral aspect process expanded apically; lateral lobes of pygofer in lateral view moderately produced ventrad of midlength of posterior margin; in ventral aspect lateral lobes diverging; apodemes moderately developed, about even with anterior margin of eighth sternite. Anal segment as in figures 451, 496, and 546; in dorsal view distinctly longer than wide (width to length 7.3:10); slightly asymmetrical, left side expanded a little more than right side; medioapical margin straight or nearly so; in caudal view ventral profile slightly asymmetrical, primarily convex.

Oliarus arizonensis, new species, is one of the most distinctive North American species. The uniformly brown tegmina, small size, and restricted range separate it easily from most forms except *O. humilis* (Say) and certain brown forms of *O. zyxus* Caldwell (see discussion *humilis*). Also, it apparently sufficiently resembles the southern Mexico species, *O. nigroalutaceus* Fowler, to cause confusion with this species. The male terminalia provide conclusive diagnosis for *arizonensis*. The most distinctive feature of *arizonensis* is the serrate, platformlike, left-ventral (sinistral) process. The total of four processes in the aedeagal complex is unusually low. Another diagnostic character is the large medioventral process of the pygofer, which in ventral aspect is almost as long as the lateral lobes of the pygofer and almost as broad as one of these lobes. The styles of arizonensis are unusual in the bifid character of the apex of the recurved portion.

Variations include slight differences in shape and serrations of the anvillike sinistral process of the periandrium and presence or absence of a spine or minute fork midlength on the right side of the median ventral process of the periandrium. Figure 98 shows this subprocess. The tegmina and wings are subject to usual variation; apex of each tegmen usually with branching as follows: Sc two, R two, M five, Cu_1 two.

Oliarus arizonensis, new species, is described from the male holotype, female allotype, 13 male paratypes and 10 female paratypes from the Santa Rita Mountains, Arizona, July 18, 1931 (E. D. Ball), all in the United States National Museum, plus other paratypes in this and other museums. The holotype is one of three specimens on the same cardboard point. It is on the tip of the point. The female allotype is next to the pin on the same point. A male paratype is in the middle. The top label reads "San Rita Mt., Ar." and "E. D. Ball" machine printed, "7-18-31" in black India ink. Also on the pin is the label "F. W. Mead Specimen No. XI-11655." Holotype, allotype and paratype labels are also affixed to the pin. Additional United States National Museum paratypes are as follows: one male, three females from "La Osa R., Ar., 9-7-35, E. D. Ball"; one male, one female from "Babo q.v. Mts., Ar., 8-6-34, E. D. Ball"; six males, two females from "Sabino Can., Ar., 8-10-32, E. D. Ball";

two males from "San Cata Mt., Ar. 7-17-30, E. D. Ball"; four males, three females from "Sta. Cruz Rv., Ar., 8-6-32, E. D. Ball." The following paratypes are from the Ohio State University: one male, "Tuscon (sic), Ariz., VIII-16-36, J. M. Knull"; one male, "Tucson, Ar., VIII-16-40; (D. J. and J. N. Knull)"; one female, "Santa Rita M., Ar., VIII-11-36, J. N. Knull." From the University of Kansas collection: one male, "Tubac, Ariz., August 21, 1935, R. H. Beamer"; one male, "Baboquivari Mts., VII-24-41; R. H. Beamer"; one male, "Arivaca, Ariz., VII-26-41; E. L. Todd."

Oliarus arizonensis has been misidentified in the Ohio State University collection and United States National Museum collection as "Oliarus nigro-alutaceus Fowler," as a result of Ball's 1934 interpretation of O. nigro-alutaceus. Dr. W. J. Knight, Head, Hemiptera Section, British Museum (Natural History), compared male terminalia drawings from Arizona specimens with a topotypic male paratype of nigro-alutaceus. He found appreciable differences in the styles, anal segment, and the aedeagus of the two forms. In his letter to me, he wrote, "the latter [O. nigro-alutaceus] aedeagus is devoid of the serrate globe on the left side, has the ventral process straight and directed posteriorly with the left arm of apical bifurcation approximately one-half length of right, and has the main shaft narrower, curved laterally to the left and then anteriorly, and terminating in three elongate processes. The dorsolateral process you [Mead] illustrate on the right hand side of the complex is also absent."

The known range of Oliarus arizonensis is restricted to certain areas of southeastern Arizona. No specimens are known from Cochise

County, Arizona, and the Pima County records are all in the eastern half of that county. The type locality of "Santa Rita Mountains" leaves some doubt about the county in which the specimens were collected, because about half of this mountain range lies in northern Santa Cruz County, the other half in southeastern Pima County. Torre-Bueno (1937) listed the elevations of the Santa Rita Mountains from 4,600 to 9,400 feet. He mentioned that E. D. Ball and other collectors did the greater part of their collecting in the canyons. The habitat of this species seems fairly restricted, since the examination of an abundance of material collected in other regions and habitats of Arizona does not include this species.

O. arizonensis, new species, does not appear to be closely related to any of the other species included here.

The seasonal distribution shows the earliest date as July 13, the latest September 7. This suggests the species is univoltine.

OLIARUS TEXANUS METCALF

Figures 25, 26, 90, 91, 233, 234, 305, 343, 402, 447, 492, 542

Oliarus texanus Metcalf, 1923. J. Elisha Mitchell Soc. 38:181; Figures 275, 572 (Key:161).

Oliarus texanus; Ball, 1934. J. Wash. Acad. Sci. 24:269-270, 275 (Synonymized in error under *Oliarus concinnulus* Fowler).

Oliarus texanus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:106 (Two references, 1923, 1927).

Length of male 3.7 to 4.4 mm (based on 51 specimens); holotype male 4.0 mm. Ground color of vertex and disc of mesonotum medium brown, lateral areas of mesonotum usually fuscous; mesonotal carinae concolorous or a lighter brown. Head: Vertex moderately broad, sides subparallel, length in middle line equal to width at apex of posterior emargination; median carina varying from short and feebly elevated to approximately half the length of the disc and moderately elevated. Face fuscous to castaneous; carina prominent varying from brownish orange to pale yellow; median carina yellowish and percurrent; lateral carinae pale along frons and postclypeus, slightly more distinct on frons; maculae not present in usual sense, but lateral carinae usually slightly widened at epistomal suture; frons moderately broad, distinctly wider than length in middle line. Rostrum of moderate length, attaining caudal margin of posterior trochanters or not.

Thorax: Pronotum with intermediate carinae usually narrowly separated from pale border of posterior margin. Mesonotum with carinae moderately and equally prominent, except intermediate pair which usually becomes weaker or evanescent cephalad. Tegmina usually lightly spotted at crossveins and forks of Cu_1 and Y-vein, occasionally immaculate in basal half; tubercles prominent, veins generally pale yellow to light brown, usually darker at apex; apical cells normally 11 and anteapical cells 6; stigma moderately narrow, usually light brown. Legs brownish basally, becoming lighter distally, lacking alternate pale and dark bands.

Male terminalia: Aedeagal complex as in figures 90 and 91; total pointed processes usually eight or nine, somewhat subject to interpretation. Periandrium with eight processes, including three very short basiventral processes; dextral process long, slender, directed caudad primarily, but also somewhat to the right, more so apically, reaching level of aedeagal joint; sinistral process stout basally, unequally forked apically into two prominent rami, the outer ramus nearly straight and directed left-caudad approximately 45 degrees as viewed ventrally; inner ramus of sinistral process angling somewhat dorsad and nearly straight to the right, having caudal hump which gives it an avicephaliform appearance; periandrium ventrally with apical process directed left-caudad initially, then recurving and changing to right-ventrocephalad direction apically, much stouter basally; ventral left side at midlength with short, slender process directed primarily left ventrad. Flagellum directed to the left, failing to complete 90 degree curve in relation to long axis of periandrium but curving through 90 degrees in relation to aedeagal apodeme; flagellum with a short, ventral, subapical process directed right-cephalad, usually entire, but bifid apically in one of the paratypes; membranous lobe near ventral apex directed cephalad and containing internal strut or process (this might be counted as an "external" process of the flagellum if care is not taken to observe hyaline covering). Styles as in figures 233, and 234; nearly symmetrical; each shaft short, with prominent hump or swelling basally, apically enlarged and recurved, angulate at apex of recurved portion and with a short, acute process near curvature and junction with shaft; inner processes prominent, triangular, longer than broad. Connective as in figure 305; moderately long and slender; combined width of ventral arms substantially greater than width of base of shaft in posterior aspect. Pygofer as in figures 25, 26, 343, and 402; symmetrical or nearly so; medioventral process in ventral aspect triangular, longer than wide, slightly longer than half the distance between its base and level of apices of pygofer lateral lobes; lateral lobes in ventral aspect rather stout, subcylindrical, tending to be slightly enlarged near or at apex; in lateral aspect lobes well but unevenly produced, left lobe tending to have slight concavity near apex. Anal segment as in figures 447, 492, and 542; somewhat asymmetrical in dorsal view, almost as wide as long; caudoapical margin usually slightly convex; ventral profile in caudal aspect slightly concave.

Oliarus texanus Metcalf is a common species in southern Texas and has been taken in southern Mexico. In external appearance it most closely resembles O. difficilis Van Duzee, under which distinguishing characters are treated. Ball (1934), not having seen the type of O. concinnulus Fowler and relying on the original description, mistakenly synonymized texanus under concinnulus. The male terminalia of texanus are vastly different from the terminalia of concinnulus, and from any other species I have seen. The male terminalia of the concinnulus holotype are illustrated in Fennah (1945b).

The type material of Oliarus texanus Metcalf is located in the collection of the Illinois Natural History Survey. The type was examined and drawings included here were made from it. The holotype male is from Brownsville, Texas, November 21, 1911, palm jungle sweepings; allotype female same data; paratypes: male, Brownsville, Texas, December 9, 1911, sweepings; male, Brownsville, Texas, November 19, 1911, in pasture, South Texas Garden; female, Brownsville, Texas, November 23, 1911, in pasture, South Texas Garden. I found the female paratype to be O. difficulis Van Duzee, not texanus Metcalf. The allotype female of O. vittatus Metcalf, in the Natural History Survey collection, is texanus, not O. concinnulus Fowler as indicated by Ball (1934).

Specimens were examined from MEXICO: Chiapas: one male, five miles East of Cintalapa, 3-IV-1953; Michoacan: three males from Morelia, 9-30-45; Veracruz: one male, Cotaxtla Experiment Station, Cotaxtla, VI-23-62; UNITED STATES: numerous other males and females from the following Texas counties: Bee, Bexar, Cameron, Dimmit, Eastland, Gillespie, Hidalgo, Jeff Davis (Davis Mountains), LaSalle, Lavaca, McLennan, San Patricio (Corpus Christie Lake), Uvalde, Victoria, and Webb. The great majority of the specimens were collected in the Lower Rio Grande Valley.

Data labels on specimens of Oliarus texanus Metcalf include: "at light," "cotton" [Gossypium sp.]," Monarda citriodora" [Cervantes]," on Ratibida columnaris" [David Don], "on peach foliage" [Prunus sp.], and the type data.

Specimens of Oliarus texanus Metcalf have been collected in all months of the year.

OLIARUS PYGMAEUS BALL

Figures 100, 101, 243, 244, 310, 349, 407, 408, 452, 497, 547

Oliarus pygmaeus Ball, 1938. Bull. Brooklyn ent. Soc. 32:180-181.

Length of male 3.0 to 3.4 mm (based on 17 specimens). Ground color of vertex and mesonotum varying from fuscous to ochre; carinae of mesonotum orange. Head: Vertex unusually narrow, length in middle line approximately one and eight-tenths times the width at apex of posterior emargination; median carina varying from nearly absent to almost as long as disc; foveae moderately narrow, length approximately three times width. Face brown, frons lighter brown than in clypeus of some specimens; carinae of frons pale yellow and unusually prominent, the expanding carinae and pale color stopping abruptly at the epistomal suture, lateral carinae of postclypeus dull orange and moderately developed; median carina of postclypeus mostly obsolete, appearing again and dull orange at anteclypeus; maculae absent; frons width greater than length in middle line, its length slightly more than two-thirds width. Rostrum short, failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae interrupted by a darkly pigmented short gap near hindmost part of curve, and narrowly separated from the pale border of posterior margin, except in some specimens where they are tangential. Mesonotum with carinae moderately prominent, intermediate pair closer to median carina posteriorly, closer to lateral pair of carinae anteriorly, and weaker, barely raised above surface. Tegmina pale with numerous small brown spots usually on crossveins, union of Y-veins, and immediately basad of stigma; veins pale throughout except very near apex; tubercles large, numerous, and especially prominent because of their brown color imposed on pale veins; apical cells seven or eight and anteapical cells four or five, branches of veins normally reaching apex: Sc one, R two, M three or four, Cu_1 one, the latter with Cu_{1b} confluent with Cu_{1a} a short distance before apex; stigma yellowish white to light brown, narrowly triangulate. Legs much paler than in most species of Oliarus.

Male terminalia: Aedeagal complex as in figures 100 and 101; total pointed processes five. Periandrium with three processes, none dorsal; without dextral or sinistral processes in the sense of processes originating basilaterally; right lateroapical area giving rise to a prominent rather slender process directed caudad for basal half, then curving approximate 90 degrees to left, becoming fairly straight, curving slightly ventrad, and ending near mediocaudal margin of flagellum; left-ventroapical area of periandrium giving rise to two long processes, both directed ventrocephalad; the shorter of these two processes straighter than the longer one which curves more cephalad and is somewhat crenulate. Flagellum directed left and with two subequal, tusklike, moderate-sized processes in the ventroapical area; both processes regularly curving, the apices pointing right-dorsocephalad. Styles as in figures 243 and 244; nearly symmetrical; apices rounded, strongly recurved, becoming slender, subacuminate, apex of recurved portion diverging from shaft; inner processes short, little more than an aborted ridge.

Connective as in figure 310; rather long and slender; combined width of ventral arms distinctly greater than width of base in posterior aspect. Pygofer as in figures 349, 407, and 408; medioventral process in ventral aspect elongate-triangular, length slightly more than twice the width, broadest at or near base, extending posteriorly approximately three-fourths the distance to level of apices of pygofer lateral lobes; lateral lobes in ventral aspect directed nearly straight caudad, rather thick, bluntly rounded at apices; lobes in lateral aspect symmetrical, produced in a peculiar, comparatively narrow, somewhat beaklike shape. Anal segment as in figures 452, 497, and 547; in dorsal view longer than wide, nearly symmetrical, medioapical margin truncate; in caudal view ventral profile deeply concave, asymmetrical, general appearance hoodlike.

Oliarus pygmaeus Ball is the smallest Nearctic species and one of the rarest, no specimens having been discovered in museums other than the original series taken by E. D. Ball on August 9, 1937, at Willcox, Arizona. Ball (1938) made ample comparisons of pygmaeus with O. apache Ball, which is one of the species that resembles pygmaeus. These two species and other somewhat similar species are discussed above under apache. The small size, pale coloration, and heavy punctures on the veins of pygmaeus are distinctive; the brown spot immediately basad of the stigma is highly unusual; the reduced venation of the tegmina, especially the consistent, apical, confluence of Cu_{1b} with Cu_{1a}, is diagnostic; the male terminalia, especially the aedeagal complex, are diagnostic without recourse to other characters.

The holotype female, allotype male, and 14 paratypes were collected by E. D. Ball at Willcox, Arizona, August 9, 1937. These and additional specimens with the same data are in the United States

National Museum. The host label on the specimens is simply, "*Dondia*." *Dondia* is a genus of plants, members of which are characterisitic of the alkaline areas of western North America.

The original description by Ball (1938) stated that the tegmina are "without the setigerous bristles." I have seen several specimens with bristles and believe those without bristles have had the bristles knocked loose by the rough action of a sweep net. The relationship of *Oliarus pygmaeus* Ball to other species is questionable, since it does not closely resemble any species I have seen; however, it seems closest to *O. altanus* Ball. The superficial resemblance of the tegmina to some of the smaller members of the *O. aridus* group may be the result of adaptations to similar environments.

Ball, in his original description, did not elaborate on the habitat of *O. pygmaeus.* The elevation of Willcox is approximately 4,160 feet above sea level. There are large cattle ranches in the hills and valleys around Willcox. This small town lies in the north-central part of Cochise County, Arizona. Maps show a dry area called "Willcox Flat" to the east and south of Willcox. Since the label "*Dondia*" is on the pinned specimens of *pygmaeus,* and certain species *Dondia* are characteristic of the arid alkali flats, there is some reason to believe Ball may have collected *pygmaeus* in or near the Willcox Flat.

Oliarus pygmaeus Vilbaste, described as new in 1961 and ranging in southeastern Europe, is a junior homonym of *Oliarus pygmaeus* Ball. In 1965 I wrote to Mr. Vilbaste suggesting that he publish a new name for his species.

OLIARUS PAPAGONUS BALL

Figure 62, 63, 204, 205, 288, 328, 382, 433, 478, 528

Oliarus papagonus Ball, 1934. J. Wash. Acad. Sci. 24:272.

Length of male 3.7 to 4.2 mm (based on 30 specimens); allotype male nearly 4.2 mm. Ground color of vertex and mesonotum usually piceous, shading to fuscous in some specimens; mesonotal carinae concolorous. Head: Vertex width moderate, sides parallel or nearly so, length in middle line slightly greater than width at apex of posterior emargination; median carina short or absent. Face brown, unusually shiny, evenly convex; median carina obsolete at basal fork and postclypeus, weakly elevated on frons and anteclypeus, almost concolorous with face in some specimens, dull orange or orange-brown in others; lateral carina narrowly but distinctly yellowish or orange on frons, very narrow, faint orange on postclypeus; maculae absent; frons broad, with width greatly exceeding length in middle line. Rostrum of median length, varying from not quite attaining caudal margin of posterior trochanters to slightly surpassing them.

Thorax: Pronotum with stramineus intermediate carinae joining pale band of posterior margin. Mesonotum broad, tumid, shiny, and with all carinae obscure. Tegmina translucent and with three transverse brown bands in the better marked specimens, but usually with a basal band only; basal band extending narrowly and evenly from costa to costa at level of posterior margin of mesonotum; middle band poorly developed in males, extending on dorsum between forks of Cu_1, brownest at commissure; apical area with membranous areas narrowly embrowned adjacent to the crossveins only, but females usually with whole apical third smoky; tubercles moderately prominent, concolorous with brownish veins; apical cells normally 11 and anteapical 6; stigma with length usually two to two and one-half times width, pale area at node extending farther distad than in most species of Oliarus. Legs with femora brown, tibiae and tarsi yellowish.

Male terminalia: Aedeagal complex as in figures 62 and 63; total pointed processes five. Periandrium with three processes; dextral process prominent, swollen in basal half, abruptly reduced and slender in distal half with slender portion initially curving dorsad and slightly to the left, apically curving ventrad, terminating close to aedeagal joint, distal half partially hidden from ventral view; sinistral process (left basiventral process) long and straight in ventral aspect, swollen in basal half, slender distally, tapering to a point, terminating at a level approximately even with most posterior development of aedeagus complex; left ventroapical area of periandrium with a prominent process that is directed left-caudad in the basal half, thence curving more than 90 degrees to extend primarily in a cephalic direction; no processes developing on the dorsal periandrium. Flagellum making a narrow, somewhat abbreviated loop left, then right-cephalad; apex of flagellum with moderately long, slender process, curving right-ventrad; outer midlength of flagellum with an acute process directed ventrocephalad primarily but with apex curving to the left. Styles as in figures 204 and 205; symmetrical or nearly so; each shaft fairly straight, moderately long and slender; apex unevenly expanded and recurved; inner processes with long ridge but apex short and slender. Connective as in figure 288; moderately proportioned; combined width of ventral arms greater than width of base in posterior aspect. Pygofer as in figures 328 and 382; symmetrical or nearly so; medioventral process in ventral aspect longer than wide, the basal two-fifths cylindrical, distally abruptly narrowed and tapering to subacute apex; process extending posteriorly half the distance to level of apices of pygofer lateral lobes; lateral lobes appearing stout in ventral aspect, moderately and unevenly produced in lateral aspect, most posterior portion of caudal margin slightly ventrad of midlength. Anal segment as in figures 433, 478, and 528; in dorsal view somewhat pyriform, left side expanded slightly more than the right side, ventroapical margin convex; in caudal view extremely hoodlike; ventral profile with middle portion a huge inverted "V".

Oliarus papagonus Ball is a very distinctive species with a sufficient resemblance to species of the *O. aridus* Ball group to merit tentative assignment to this group. It is the only member of this group to have only two processes on the flagellum, the other species having three to five. The anal segment alone is sufficient to identify *papagonus*, this structure being extremely hoodlike or tectiform subapically, the medioventral profile in caudal view being a large inverted "V". *O. papagonus* is one of the species that can be identified readily in either sex without recourse to dissections. The combination of obscure carina, broad, dark, shiny, tumid mesonotum and face, together with small size and transversely banded tegmina, make the species unusually distinctive. Morphological variation is minor in the specimens examined.

Ball listed the type series of _Oliarus papagonus_ as the holotype female, allotype male, and 13 paratypes from Eloy, Arizona (Pinal County). They were collected June 3, 1933, by Ball, on mesquite trees [_Prosopis juliflora_ (Swartz) D C.] growing in an area where _Lycium_ sp. was abundant. According to Nichol (1937), squawberry (_Lycium_) is typical of the more open stands of mesquite woods in the southern desert of Arizona. Nichol commented further that mesquite is characteristic of the deep alluvial soils that have built up following water courses and also where subterranean water is available. The only other "host" information is that a specimen collected by E. D. Ball at Patagonia, Arizona, July 20, 1930, has a label "_Condalia_." Arizona species of this genus of the Rhamnaceae are spiny shrubs common to hot sandy washes and narrow gullies.

The type series of _Oliarus papagonus_ Ball is in the United States National Museum. The pin with the red holotype label has three females on one paper point. The pin with a red allotype label has a male at the apex of the paper point, a female next to the pin, and a male. A pin with a blue paratype label has a male (used to illustrate this paper) on the apex of the paper point and two females on broader portions of the point. Twenty-five other specimens having label information identical to the type were discovered in the United States National Museum.

The known range of Oliarus papagonus Ball is confined to the Arizona counties of Cochise, Maricopa, Pima, Pinal, Santa Cruz, and Yavapai.

Known collecting dates extend between June 3 and August 20.

OLIARUS CINNAMOMEUS PROVANCHER

Figures 70, 71, 213, 214, 294, 332, 388, 389, 437, 482, 532

Oliarus cinnamomeus Provancher 1889. Petite Faune ent. Canada:223.

Oliarus cinnamomeus: Ball, 1934. J. Wash. Acad. Sci. 24:270-271 (Key).

Oliarus cinnamomeus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:55-56 (Catalog of 12 references 1889-1928).

Oliarus cinnamomeus; Osborn. Ohio biol. Surv. Bull. 6:299, 302. (Key, notes).

Oliarus cinnamomeus; Beirne, 1950. Can. Ent. 82:93-94 (Key, notes).

Length of male 5.7 to 5.9 mm (based on 12 specimens). Ground color of vertex and mesonotum fuscous; carinae of mesonotum usually concolorous, occasionally a contrasting light brown. Head: Vertex unusually broad, length in middle line less than width at apex of posterior emargination (1:1.1 - 1.3); median carina variable, feebly developed in some specimens, extending anteriorly as much as half length of disc in other specimens. Face fuscopiceous, carinae prominent, lighter brown to dull orange; median carina percurrent, lighter color entire length distad of basal fork; frons wider than length in middle line (1.2 - 1.4:1). Rostrum usually not quite attaining caudal margin of posterior trochanters, apex approximately even with caudal margin in some specimens.

Thorax: Pronotum with intermediate carinae not joining pale border of posterior margin. Mesonotum with all five carinae strongly prominent, the lateral carinae tending to be slightly less conspicuous than the middle three. Tegmina entirely smoky brown except for pale costa and stigma; tubercles comparatively large but inconspicuously concolorous with brown veins; venation subject to usual variation in branching but tegmina usually with 11 apical and 6 anteapical cells; stigma pale, triangular, length three and one-quarter times the width. Legs with tibiae and tarsi lighter than basal segments; first and second metatarsites having unusual number of apical spurs, with basal tarsite of each metatarsus usually having 12 apical spurs, including lateral pair, but each one of the 10 spurs between lateral pair having a small membranous scalelike tooth attached distally, the variation in number of spur-scale combinations ranging from 8 to 11; second tarsite of each metatarsus having 9 to 11 apical spurs, including lateral pair, with 7 to 9, usually 8 or 9 spur-scale combinations present between lateral pair.

Male terminalia: Aedeagal complex as in figures 70 and 71; total pointed processes five, plus a platelike sinistral process. Periandrium with one pointed process and a platelike process; dextral process unusually long and curved, extending straight caudad to level of aedeagal joint, then slightly enlarging and making falciform curve to the left, becoming slender, terminating dorsad of flagellum, and pointing left-cephalad; sinistral process platelike, extending dorsoventrally, and in some specimens with a few spicules. Flagellum curving left only a short distance before turning and extending fairly straight in cephalic direction; with four pointed processes; apically with a short, slender, acute process, wholly visible only in dorsal aspect; basiventral area of flagellum giving rise to three processes, all pointing or curving left-cephalad, the middle process longest; the shortest and straightest process closest to the posterior margin of the platelike process. Styles as in figures 213 and 214; symmetrical or nearly so; shafts stout, each apex rounded and recurved but the recurved portion becoming pointed at apex; inner processes ridgelike, without apical digitate extension. Connective as in figure 294; moderately long and slender; combined width of ventral arms slightly less broad than base of shaft in posterior aspect. Pygofer as in figures 332, 388, and 389; medioventral process in ventral aspect fairly long and slender, length approximately three times width, middle portion swollen; extending posteriorly two-thirds to three-fourths the distance to level of apex of left pygofer lobe; pygofer lobes asymmetrical in ventral or lateral aspect, moderately produced; left pygofer lobe broadly produced, but right lobe produced into a thumblike lobe at midlength of posterior margin. Anal segment as in figures 437, 482, and 532; symmetrical or nearly so; in dorsal aspect conspicuously longer than broad; medioapical margin slightly concave; in caudal aspect ventral profile broadly concave but straight between lateral ventral extensions; hoodlike.

Oliarus cinnamomeus Provancher, a somewhat rare and local northern form, is closest to *O. habeckorum,* new species, the latter usually having been hitherto determined as *cinnamomeus*. Means of distinguishing between *cinnamomeus* and *habeckorum* are discussed under the latter species. Some other species which might be confused with *cinnamomeus* are the smaller *O. humilis* (Say) and melanic specimens of the *O. placitus* Van Duzee group. *O. cinnamomeus* is readily diagnosed by the whitish slender costa and stigma contrasting with the fuscous tegmina. The male terminalia are definitive. Another very useful character is the set of scalelike teeth on the apices of the posterior basal and middle tarsites.

The type of Oliarus cinnamomeus Provancher was collected at Vancouver [British Columbia, Canada] by Rev. G. Taylor. In 1967 Mr. René Béique examined the female type of O. cinnamomeus Provancher for me. The specimen is in the Musée du Québec, Quebec, Canada. Mr. Béique carefully examined the type which he wrote "is still in excellent condition apart from some discoloration. But, still as in the description, the very characteristic whitish costa and stigma are quite striking."

Specimens were examined from CANADA: Ontario, Eldorado. UNITED STATES: Connecticut: Colebrook; Maine: Hooper, Norway, Whitneyville; Massachusetts: Sharon, Wincheldon; New Hampshire: Mount Washington; New Jersey: Ramsey; New York: Cold Spring Harbor, Long Island; Pennsylvania: "266:66 Belfrage" [G. S. Belfrage, collector; specimen in Riksmuseum Stockholm].

Thus, the known range of Oliarus cinnamomeus Provancher is in the northeastern United States except for the type locality of Vancouver in British Columbia and one locality in Ontario.

Oliarus cinnamomeus Provancher and the closely related O. habeekorum, new species, are very distinct from other North American species but probably closer to the exoptatus group than other Nearctic forms. Both the exoptatus group and O. cinnamomeus and O. habeckorum appear somewhat allied to Palearctic forms.

Van Duzee (1923) wrote that he had collected Oliarus cinnamomeus only on bogs where huckleberries [Vaccinium sp.] grow. Osborn (1938) referred to O. cinnamomeus as a northeastern [U. S.] species "said to occur in bogs where blueberries grow and may be looked for in blueberry association." The Eldorado, Ontario, specimen was collected in a sphagnum bog by G. S. Walley, July 13, 1944. This specimen is used in the illustrations below; I have placed a plesiotype label on the pin. A specimen from Maine has "cherry field" on the habitat label. Possibly this is local vernacular for a cranberry bog.

The known seasonal distribution of O. cinnamomeus is from June 25 to August 16.

OLIARUS HABECKORUM, NEW SPECIES

Figures 68, 69, 210, 211, 212, 292,
293, 331, 386, 387, 436, 481, 531

Length of male 6.7 to 7.2 mm (based on 12 specimens); holotype male 6.9 mm. The following description is of the holotype. Ground color of vertex and mesonotum varying from stramineous to testaceous; mesonotal carinae with lateral pair mostly fuscous, intermediate pair yellowish, and the median carina mostly orange. Head: Vertex very broad, length in middle line much less than width at apex of posterior emargination (1:1.4); median carina of disc not present as a distinct ridge but as a broad, indistinct, slightly raised portion. Face fuscous; concave between elevated carinae; median carina conspicuously forked at base, percurrent, and yellowish from apex of fork through anteclypeus; lateral carinae stramineous entire length, with pale color widened at and somewhat basad of epistomal suture, forming what could be interpreted as long and narrow maculae; frons moderately narrow, ratio of width to length in middle line 50:41. Rostrum light yellowish brown, except fuscous at apex of terminal segment; length moderately long, not attaining caudal margin of posterior trochanters but slightly surpassing posterior coxae.

Thorax: Pronotum with pale yellow intermediate carinae not joining broad, pale yellow border of posterior margin. Mesonotum with all carinae conspicuous. Tegmina with all membranous areas light to medium brown, costal and apical cell areas darker brown; costa and stigma whitish to stramineous; tubercles concolorous, not conspicuous, but comparatively large; veins generally brownish, lighter brown in middle and basal areas; left tegmen at apex with Sc two-branched, R two-branched, M six-branched, and Cu_1 two-branched; apical cells 12 and anteapical cells 6; right tegmen at apex with Sc two-branched, R two-branched, M five-branched, and Cu_1 two-branched; apical cells 11 and anteapical cells 6; stigma length two and one-half to three times width, interior border of stigma somewhat indistinct. Wings with dusky membranes, R with two branches reaching apex, M with three branches reaching apex, triangle formed by veins of R shorter than triangle formed by anterior veins of M. Legs with front and middle femora and tibiae mixed fuscous and testaceous but not banded; posterior femora mostly brownish, posterior tibiae and tarsi testaceous to stramineous; each posterior tibia with three lateral spines, the basal one smallest, and with six apical spurs; basal tarsite of left posterior tarsus with 18 apical spurs, including lateral pair, but each one of the 16 spurs between lateral pair having a small membranous, scalelike tooth attached distally; basal tarsite of right posterior tarsite with 18 spur-scale combinations and 2 lateral spurs for a total of 20 spurs; second tarsite of left posterior tarsus with 14 spur-scale combinations and 2 lateral spurs for a total of 16 spurs; second tarsite of right posterior tarsus with 16 spur-scale combinations and 2 lateral spurs for a total of 18 spurs.

Male terminalia: Aedeagal complex as in figures 68 and 69; total pointed processes five, plus a platelike process. Periandrium with one pointed process and a platelike process; dextral process stout and very long, directed caudad initially, then broadly curved left-caudad, left, left, left-cephalad, and terminating straight cephalad; dextral process with distal portion on dorsal side of aedeagal complex rather than ventral side; sinistral process laterally compressed, platelike, extending dorsoventrally. Flagellum curving left only short distance before turning and extending fairly straight cephalad; with four pointed processes; apically with a short, slender, acute process, wholly visible only in dorsal aspect; basiventral area of flagellum giving rise to two processes, both curving left-cephalad, the outer process nearly twice as long as the inner dorsally, with an additional prominent process arising at the base of the flagellum, curving left-cephalad initially, then cephalad, extending anteriorly almost as far as apex of flagellum. Styles as in figures 210, 211, and 212; nearly symmetrical, apex of style rounded and recurved, apex of recurved portion somewhat digitate; shaft broad whole length except where joining expanded apical portion; inner processes ridgelike, basal part abruptly elevated from shaft, not gradually confluent as in most species of Oliarus. Connective as in figures 292 and 293; moderately long and slender; in lateral view slightly curving; in posterior view, slightly asymmetrical, base of shaft slightly tilted to the left; combined width of ventral arms less than width of base of shaft. Pygofer as in figures 331, 386, and 387; asymmetrical; medioventral process in ventral aspect fairly long and slender, length approximately twice width, middle portion slightly swollen, basal portion slightly narrowed, apex acute; extending posteriorly slightly less than half distance to level of apex of left pygofer lobe; pygofer lobes asymmetrical in ventral or lateral views, the left lobe slightly shorter and stouter, broadly rounded in lateral view; right pygofer lobe longer and more narrowly produced in both ventral and lateral views; caudalmost portion of right lobe closer to midlength of posterior margin than in the left lobe. Anal segment as in figures 436, 481, and 531; nearly symmetrical in dorsal view, longer than broad, medioapical margin concave; in left lateral view with central tube or keel hidden only at middle portion by left lateral margin of segment; in caudal view asymmetrical, left margin extending considerably more ventrad than right margin; medioventral profile with keellike aspect, ventral profile primarily convex between lateral margins and somewhat diagonal.

Oliarus habeckorum, new species, is a comparatively rare species which previously has been misdetermined as O. cinnamomeus Provancher. The two species are morphologically close, but there are several consistent differences. Most readily apparent is the overall lighter shade of brown of habeckorum, particularly in the tegmina; habeckorum males are larger, measuring over 6.5 mm in total length, whereas cinnamomeus males are under 6.0 mm. The aedeagal complex of cinnamomeus has a short, straight, almost spinelike process near the posterior margin of the platelike sinistral process, but habeckorum has a longer, stouter, curving process in this area; the platelike process of habeckorum is a little larger than in cinnamomeus. A prominent curved process at the base of the flagellum, originates ventrally on cinnamomeus, but dorsally on habeckorum; the anal segment in caudal view is nearly symmetrical in cinnamomeus but that of habeckorum is considerably asymmetrical, with a central "keel" more prominent; the medioventral pygofer process of _cinnamomeus_ extends caudad two-thirds to three-fourths the distance to the apex of the left lateral lobe of the pygofer, but in _habeckorum_ it extends caudad one-half or less this distance. The number of scalelike teeth at the apex of the basal metatarsite of _cinnamomeus_ is 8 to 11, usually 10 to 11, but in _habeckorum_ the number of scalelike teeth is 14 to 18, usually 15 or 16; this same character in the second (middle) metatarsite ranges from 6 to 10, (usually 8 or 9) in _cinnamomeus_, but ranges 11 to 16 (usually 12 to 14) in _habeckorum_.

Intraspecific variations include some specimens of _Oliarus habeckorum_ with spicules on the sinistral process of the periandrium; other specimens are without such spicules; lateral spines on each posterior tibia usually are three but vary from two to four; the tegmina and wings subject to the usual slight variation in branching; the color on the mesonotum of some specimens is a deeper brown than on the majority of specimens.

Oliarus habeckorum, new species, is described from the male holotype, female allotype, five male paratypes, five female paratypes, all collected at Clemson College, South Carolina, June 8, 1935, by O. L. Cartwright, sweeping cane, plus one male paratype with the same data except for the date which is July 12, 1935. These specimens are a part of the D. M. DeLong collection in the Ohio State University collection. The holotype bears F. W. Mead Specimen No. III-21671. Other paratypes include two males from Southern Pines, North Carolina, 1952, (B. K. Dozier) Florida State Collection of Arthropods; a male and a female from "S. P. 64" [Southern Pines, North Carolina], and a male from Swan Quarter, North Carolina, VI-30-53 (W. M. Kulash), light trap, these three specimens from the North Carolina State University collection; one male, two females from Emporia, Virginia, July 24, 1939 (P. W. Oman) and one male paratype, Wayne County, North Carolina, 15-VII-55 (H. V. Weems, Jr.) United States National Museum Collection.

Thus, the known range of Oliarus habeckorum is limited to three counties in the eastern half of North Carolina, one county in northwestern South Carolina, and one county in southeastern Virginia, bordering North Carolina. These localities are south of 37 degrees north latitude; the localities of O. cinnamomeus are north of approximately 40 degrees north latitude.

Oliarus habeckorum, new species, and O. cinnamomeus Provancher are close and very distinct from other North American species, although one or more of the European forms may be fairly similar to them. There is considerable evidence that O. villosa (Fabricius) is close to habeckorum. O. villosa was described by Fabricius in 1775 and he listed 'America' as the locality. Later (1803) he gave "America meridionali" [South America] as the locality. Stål (1869) believed O. villosa to be related to forms of eastern Europe. The type is a female, has a pin through the mesonotum, and is faded. When female characteristics of the pertinent species are better understood, it may be possible to know what modern species concept, if any, belongs with O. villosa.

Little habitat information is available on Oliarus habeckorum, new species. The specimens collected at Clemson were obtained by "sweeping cane." In this instance cane would refer to Arundinaria sp., the bamboolike grass of the river bottom areas of the southern United States. Mr. O. L. Cartwright of the Smithsonian Institution (personal correspondence April 5, 1967) wrote that Clemson is in the foothills, at 800 feet elevation on the Seneca River, but possibly the collecting site is now under water since Clarke's Hill Dam backed water much above [north of] Clemson.

The known seasonal distribution of *O. habeckorum*, new species is in June and July.

I take great pleasure in naming this species in honor of Dr. Dale H. Habeck, Associate Professor, Department of Entomology and Nematology, University of Florida, and his wife, Phyllis Pake Habeck, professional artist, who have generously given much valuable assistance during the preparation of this paper.

OLIARUS YAVAPANUS BALL

Figures 33, 92, 93, 235, 236, 306, 344, 403, 448, 493, 543

Oliarus yavapanus Ball, 1934. J. Wash. Acad. Sci. 24:274 (Key: 270-271; comparative notes 274, 276).

Length of male 3.9 to 4.6 mm (based on 26 specimens); allotype male 4.3 mm. Ground color of vertex and mesonotum usually fuscous, piceous in some specimens; mesonotal carinae orange. Head: Vertex narrow, substantially longer in middle line than wide at apex of posterior emargination; median carina usually present in basal half of disc. Face usually fuscous, castaneous or piceous in some specimens; median carina prominent, percurrent, weakly forked at base, usually orange entire length; lateral carinae usually pale yellow from base of frons to apex at postclypeus, pale color slightly broadened at epistomal suture in most specimens; frons moderately narrow, width greater than length in middle line. Rostrum short, not surpassing posterior trochanters.

Thorax: Pronotum with intermediate carinae usually narrowly separated from pale border of posterior margin. Mesonotum with conspicuous carinae. Tegmina with membrane somewhat variable from milky subhyaline to a dusky tinge throughout; some specimens with apical area distinctly browner; apical crossveins suffused, otherwise tegmen immaculate except for usual brownish area on commissure basad from Y-vein juncture; tubercles not prominent; veins pale yellow to light brown in basal two-thirds, brownish apically; apical cells normally 11 and anteapical cells 6 in most specimens; stigma brownish, length approximately twice width. Legs not banded.

Male terminalia: Aedeagal complex as in figures 92 and 93; total processes eight. Periandrium with five processes; ventrally with dextral process well developed, directed nearly straight caudad to level of aedeagal joint, then curving to the right shortly before apex; sinistral process the most distinctive process, stout basally and directed only a short distance caudad before enlarging and curving 90 degrees to the left, apical part tapering and straight, profile avicephaliform; median basal area with short, acute process directed left-caudad; left apical area with conspicuous curving process, directed primarily to the left in apical two-thirds; dorsal periandrium with median basal area giving rise to slender, acute process of medium length, slightly curved but directed primarily straight caudad. Flagellum directed left-caudad basal half, then curving left and finally left-cephalad; ventrally with short, slender, acute process arising near apex; dorsally with short, slender, acute process subapically near caudal margin and with a subbasal very short process near caudal margin, this process varying from somewhat rounded to pointed. Styles as in figures 235 and 236; symmetrical; shafts long and slender; apices rounded and recurved; inner processes moderately short, pointed. Connective as in figure 306; long and slender; combined width of ventral arms broader than base of shaft in posterior aspect. Pygofer as in figures 33, 344, and 403; symmetrical; medioventral process in ventral aspect subtriangulate, acute, longer than wide, extending posteriorly slightly less than half the distance to level of apices of pygofer lateral lobes; lateral lobes well produced, subacute. Anal segment as in figures 448, 493, and 543; in dorsal view symmetrical or nearly so; slightly longer than wide, nearly uniformly rounded; medioapical margin approximately straight; ventral margin in caudal view nearly straight, slightly concave.

Oliarus yavapanus Ball is an uncommon species, ranging in the southwestern United States. In general appearance it resembles several other species. In determined material of major United States museums, O. yavapanus occasionally has been misidentified as O. coconinus Ball, O. corvinus Ball, O. forcipatus Caldwell, and O. zyxus Caldwell, but I believe yavapanus is closest to O. uncatus Caldwell, an apparently very rare species known only from Arizona. The two most diagnostic characters of yavapanus are the avicephaliform sinistral process of the periandrium and a short process present on the subbasal, caudodorsal area of the flagellum (not present in other species under consideration).

Ball (1934) listed the type series as: "Holotype female, allotype male, and a pair of paratypes, Ashfork Aug. 16, 1929, six paratypes Ashfork July 15, 1929, three Yarnell Heights July 21, 1929, and two from the same place Aug. 20, 1929. All collected by the writer [E. D. Ball] from the higher table lands or mountains of Arizona."

I have examined most of this material, including the type and allotype in the United States National Museum. It is difficult to be certain if the female paratypes and non-paratypes are all conspecific with the holotype, but they appear to be. The male paratypes and allotype are conspecific with one another and with the holotype. Some of the paratypic material was discovered unlabeled as such in the U. S. National Museum; appropriate labels have been added. The holotype female, allotype male, and paratype male were all located on one cardboard point. The holotype was next to the pin; the male on the tip had been dissected, with the abdomen placed in a microvial. I have remounted the three specimens on separate paper points, and placed the three points on the original pin with the original labels. The illustrations are based on a paratype from Ash Fork, Arizona 7-15-29, F. W. Mead Specimen No. I-19655; it is the middle specimen of three male paratypes on one point. (There seems to be disagreement as to whether Ashfork [Arizona] is one word or two. Ball used it as one word in his original description, but the labels on his type specimens make it two words. I have noticed Ashfork on maps and atlases both as one and as two words.)

The range of _Oliarus yavapanus_ Ball, as determined from males I have studied, is as follows: ARIZONA: Mustang Mountains; Pima, Santa Cruz, and Yavapai Counties. CALIFORNIA: Pine Flats Camp, Indio, Riverside County. TEXAS: Davis Mountains, Jeff Davis County. UTAH: Chads.

Oliarus yavapanus Ball appears closest to _O. uncatus_ Caldwell, and perhaps next closest to _O. forcipatus_ Caldwell, these three species being similar enough to be considered as a group. Their external appearance is much the same and they range in the southwestern United States. The structure of the male terminalia of the species is much the same.

The labels on the specimens of Oliarus yavapanus Ball are devoid of specific habitat and host information.

The known seasonal distribution of O. yavapanus extends from June 20 to August 29.

OLIARUS FORCIPATUS CALDWELL

Figures 96, 97, 239, 240, 308, 346, 405, 450, 495, 545

Oliarus forcipatus Caldwell, 1947. Pan-Pac. Ent. 23:146.

Length of male 4.4 to 4.8 mm (based on 10 specimens); holotype male 4.6 mm. General appearance same as Oliarus yavapanus Ball and Oliarus uncatus Caldwell

Male terminalia: Aedeagal complex as in figures 96 and 97; total pointed processes six, counting a bifid sinistral process as one. Periandrium with four processes as here interpreted; dextral process stout, elongate-triangular in ventral aspect, directed right caudad, not attaining level of aedeagal joint; sinistral process broad, bifid at apex, forks short, acute and subequal; right basal area of sinistral process with a short acute process directed caudad and appearing to originate from the median basiventral area of the periandrium; margin at midlength on right side of sinistral process irregularly serrate; left ventroapical area with a prominent process, stout basally, slender and curving left-caudad in distal half; dorsal periandrium with a moderately long, slender process originating mediobasally, this process directed caudad initially, but curving to the left apically. Flagellum directed left-caudad in approximately basal half, but then curving left and somewhat cephalad, and with small process in the ventroapical area; this process swollen basally, acute and slender apically; cephalosubbasidorsal (inner) area of flagellum giving rise to an asymmetrical process that is stout basally, acute apically, and directed primarily left-cephalad. Styles (figures 239 and 240), connective (figure 308), pygofer (figures

346 and 405), and anal segment (figures 450, 495, and 545), all consistent with *yavapanus* group.

Oliarus forcipatus Caldwell is so similar to *O. yavapanus* Ball and *O. uncatus* Caldwell that examination of the aedeagal complex is necessary to distinguish the species. These three species are similar enough to form what appears to be a natural group (in general appearance certain other medium-sized brownish species in the southwestern United States approach the *yavapanus* group). The most diagnostic characters of *forcipatus* are the sinistral process of the periandrium and the distinctive, subbasal, dorsal, inner process of the flagellum. The pygofer lateral lobes of *forcipatus* are thinner and slightly more produced than in *uncatus* and *yavapanus*.

Variation in the specimens examined was minor; all specimens were in essential agreement in the holotype.

The holotype male is in the Ohio State University collection; it forms the basis for most of the present illustrations. Caldwell listed the type series as "male holotype and paratypes, July 23, 1946; female allotype and paratypes, June 2, 1937, from Davis Mts., Texas (D. J. & J. N. Knull), OSU." The allotype label unaccountably is on a male specimen from the Davis Mountains, June 2, 1937 (D. J. and J. N. Knull). Furthermore, this male is not *Oliarus forcipatus*, but is *O. altanatus* Caldwell, the allotype of which is a female. The other type material of *forcipatus* which I examined consisted of two female paratypes from Davis Mountains, June 2, 1937, and July 23, 1946. They appear to be conspecific with the holotype but it is difficult to associate females with conspecific males where several similar species are in the same area.

The known range of _Oliarus forcipatus_ Caldwell appears to be limited to a few mountain areas. Male specimens were determined from Davis Mountains, Fort Davis, and Davis Mountains, Highway 118, all in Jeff Davis County, Texas; Chisos Mountains, Brewster County, Texas, and Atasco Mountains, Arizona. No specialized habitat or host data are available.

The label data with the specimens shows June 20 as the earliest, August 16 as the latest collecting date.

OLIARUS UNCATUS CALDWELL

Figures 7, 94, 95, 237, 238, 307, 345, 404, 449, 494, 544

Oliarus uncatus Caldwell, 1947. Pan-Pac. Ent. 23:151.

Length of male 4.4 mm (holotype, unique). Vertex and mesonotum black; mesonotal carinae orange, area between outer and intermediate carinae orange. Head: Vertex narrow, troughlike, length in middle line greater than width at apex of posterior emargination (23:18). Face evenly ovate, light brown with yellowish carinae, median carina prominent; frons with width greater than length in middle line (35:28).

Thorax: Intermediate carinae of mesonotum appearing broken, irregular. Tegmina milky with yellow veins becoming darkened apically; tubercles on veins regular, not prominent; left tegmen with 12 apical cells and 6 anteapical cells; right tegmen with 11 apical and 6 anteapical cells; stigma long, narrow.

Male terminalia: Aedeagal complex as in figures 7, 94 and 95; total pointed processes seven. Periandrium with five processes; dextral process prominent, directed caudad to level of aedeagal joint, then hooklike, with apical portion curving more than 90 degrees right-cephalad; sinistral process broad, unevenly bifid at apex, with left fork broader, directed left and rounded, right fork slender, acute, and directed caudad; medioventral basal area with a very short process; ventral left apical area giving rise to a prominent recurved process that is slender for most of its length and directed primarily in a left caudal direction; dorsal periandrium with a basal, slender, apically curved, medium to small process. Flagellum directed left-caudad in basal two-thirds then curving left and cephalad; apically with a small acute process directed cephalad; subapically with a small, acute process along most posterior portion of flagellum and directed primarily to the left. Styles as in figures 237 and 238; symmetrical; each shaft long and slender, with apex rounded and recurved and inner process moderately short, pointed. Connective as in figure 307; moderately long and slender; combined width of ventral arms slightly greater than width of base of shaft in posterior aspect. Pygofer as in figures 345 and 404; medioventral process in ventral aspect subtriangulate, acute, longer than wide, extending posteriorly nearly halfway to level of apices of pygofer lateral lobes; lateral lobes symmetrical or nearly so, well produced, subacute. Anal segment as in figures 449, 494, and 544; in dorsal view nearly symmetrical, moderately longer than wide, well rounded; medioapical margin approximately straight; ventral margin in caudal view gently concave.

Oliarus uncatus Caldwell, known only from the holotype, was collected in Prescott National Forest, Yavapai County, Arizona, June 20, 1947 (D. J. and J. N. Knull). It is in the Ohio State University collection. *O. uncatus* is similar to *O. forcipatus* Caldwell, but *uncatus* has no inner, subbasal, stout process on the flagellum as in *forcipatus*. *O. uncatus* is closest to *O. yavapanus* Ball, but *yavapanus* has a short process on the dorsal, subbasal part of the flagellum that is lacking in *uncatus*, and the sinistral process of *yavapanus* is not bifid but is produced to the left and is avicephaliform, whereas in *uncatus* the sinistral process is bifid.

OLIARUS ALTANATUS CALDWELL

Figures 19, 30, 131, 132, 271, 272, 363, 511, 559, 568, 585

Oliarus altanatus Caldwell, 1951. Ohio J. Sci. 51:35.

Length of male 3.5 to 4.4 mm (based on six paratypes and three other specimens). Ground color of vertex and mesonotum usually piceous, occasionally fuscous; mesonotal carinae usually orange, but color faint or evanescent along sections of carinae in some specimens; other specimens with color spreading onto disc. Head: Vertex width variable, length in middle line from less than to more than width at apex of posterior emargination (length to width ratio 0.90:1 to 1.19:1); median carina absent or very short. Face piceous or fuscous except for pale carinae; middle carina percurrent in some individuals, becoming obsolete in postclypeus in others, pale yellow to dull orange, usually more prominent on frons; fork of median carina very short, usually broader than long; lateral carinae pale from base through postclypeus, pale border sometimes expanding at epistomal suture but not to degree of becoming distinct macula; frons moderately broad, wider than long in middle line (length two-thirds to three-fourths the width). Rostrum short, distinctly failing to attain caudal margins of posterior trochanters, sometimes by as much as half the length of last segment of rostrum.

Thorax: Pronotum with intermediate carinae usually not attaining pale band of posterior margin but sometimes becoming tangential. Mesonotum with carinae nearly uniform. Tegmina immaculate except for slightly suffused apical crossveins; veins generally brownish, more so apically; commissure mostly pale except for brown section immediately basad of union of Y-veins; tubercles moderately conspicuous, concolorous with veins; apical cells 10 to 13, usually 11, and anteapical cells 5 or 6; stigma brown, ovoid, length slightly more than twice width.

Male terminalia: Aedeagal complex as in figures 131 and 132; total pointed processes nine if both prongs of the "caliper process" are counted. Periandrium with five or six processes; ventrally, the dextral process extremely slender, and extending posteriorly barely half the distance to joint of aedeagus; sinistral process large, caliperlike, the upper and lower "jaws" or prongs equally produced or nearly so; median area of basiventral periandrium with prominent process considerably swollen at base, directed caudad initially, curving distally to extend straight left before terminating with another curve in a variable left-cephalad direction; dorsal periandrium with two processes: a long, slender process inserted basally which curves fairly regularly left-caudad, apex usually ending over middle part of flagellum in dorsal aspect with terminal direction of the process varying from straight left to approximately 45 degrees left-caudad; and a short, stout, pointed process originating from left-median, subapical area and directed left-caudad. Flagellum directed to the left and with three medium-sized processes in the apical area, smallest of the three on the dorsal surface and not visible from ventral view; apical process longest. Styles as in figures 271 and 272; symmetrical; each shaft slender, somewhat enlarged basally, apex expanded and recurved apically, broadly rounded at apex of recurved portion; inner processes rather short, pointed. Connective as in figure 585; long and slender; combined ventral arms wider than base of shaft in posterior aspect. Pygofer as in figures 19, 30, and 363; medioventral process triangular, moderate in size; in ventral view, width approximately two-thirds the length; process extending posteriorly to less than one-half the distance to the level of the apex of the left lateral lobe in most specimens, in other specimens half the distance; lateral lobes of pygofer in lateral view well produced with each apex below midlength of posterior margins, and with right lobe slightly more produced than the left. Anal segment as in figures 511, 559, and 568; moderately broad but distinctly longer than wide in dorsal view (width to length 7.3 - 8.0:10); symmetrical or nearly so; medioapical margin straight or nearly so; medioventral profile in caudal view gently concave.

Oliarus altanatus Caldwell is a member of the *O. concinnulus* Fowler group. In general, *altanatus* Caldwell is similar to several southwestern United States and Mexican species. It can be identified only from the aedeagal complex of the male, according to present knowledge. The two most diagnostic characters of *altanatus* Caldwell are the dextral and sinistral processes, best seen from the ventral aspect of the dissected and cleaned aedeagal complex; the dextral process of the periandrium is comparatively short, extremely slender, and matched in this slenderness only by the slightly longer dextral process of *concinnulus*, therefore, separation of *altanatus* from *concinnulus* depends primarily on the different shapes of the respective sinistral processes. In *altanatus* this process is caliperlike, with the apical and basal jaws of the caliper well separated, fairly similar in proportions, and parallel or nearly so (at right angles to the main shaft of the sinistral process); in concinnulus the sinistral process is only vaguely caliperlike, the apical portion being clavate, much thicker than the basal jaw or prong, and completing an insufficient portion of the 90 degree curve required to form a well proportioned caliper as normally represented by specimens of altanatus. The aedeagus complex of the type specimen of concinnulus Fowler is illustrated in the paper by Fennah (1945b).

The types of Oliarus altanatus Caldwell are in the United States National Museum. The holotype male was collected 12 miles south of Jacala, Hidalgo, Mexico, IX-26-41 (DeLong, Good, Caldwell, and Plummer). The two holotype labels on the specimen are misspelled "altanasus." The allotype female has the same collection data. Male paratypes examined by me include one from Mexico City, D. F., W. 18 km. IX-1-39; one from Zimipan, Hidalgo, Mexico, K 222, 10-31-45; two from Jalapa, Vera Cruz, Mexico, K 270, 10-31-45; one from Davis Mountains, Texas, May 13, 1927, ex mallow; Tlalpam, D. F., Mexico, X-7-23, M. B. 9. I also examined four female paratypes from Zimipan, Hidalgo; Jalapa, Vera Cruz, and Cuernavaca, Morelos. Additional material of altanatus determined by me totals four males as follows: a paratype male of O. forcipatus Caldwell mislabeled "allotype" collected at Davis Mountains, Texas, VI-2-37 (D. J. and J. N. Knull) Ohio State University collection; a male from 13 miles northwest of Comitan, Chiapas, Mexico, III-3-53 (E. I. Schlinger) California Insect Survey collection; a male from Cuernavaca, Morelos, Mexico, August 6, 1938 (L. J. Lipovsky) North Carolina State collection; Ozona, Texas, 7-9-36, R. H. Beamer, University of Kansas collection. Ozona is in Crockett County and the map elevation for Ozona is 2347 feet.

The available specimens of this uncommon species exhibit considerable variation in many of the characters studied, for example, total length, the width of the vertex, color of the face, number of vein branches reaching apex of tegmen, and details of the processes of the aedeagal complex. A paratype male from Davis Mountains, Texas, has the apical "jaw" of the caliper process recurved approximately 145 degrees for a short distance instead of 90 degrees before curving again finally to extend parallel to the basal "jaw." This specimen also has an adventitious, very short, pointed process on the periandrium in the left, subapical, median portion. Specimens from Mexico City southward tend to have the caliperlike process less strongly developed, the vertex wider, and the total length shorter.

Oliarus concinnulus Fowler is entirely Mexican, and *O. altanatus* Caldwell mostly Mexican, with a possible range overlap in Morelos. The records for *altanatus* are in southwestern Texas and in the southeastern part of Mexico. *O. concinnulus* seems to be primarily in the lower southwestern area of Mexico, but our knowledge of the Mexican fauna is poor. The known distribution of *altanatus* is disjunct to the extent that approximately 700 miles lie between the northernmost Mexican record at Jacala, Hidalgo, and the west Texas localities of Davis Mountains and Ozona.

None of the specimens examined has any host or habitat labels. The available specimens are all from plateau or mountain localities.

Specimens examined were collected in the months of March, May, and June through October.

OLIARUS CORVINUS BALL

Figures 20, 133, 134, 273, 274, 512, 560, 569, 586, 591

Oliarus corvinus Ball, 1934. J. Wash. Acad. Sci. 24:273 (Key 270-271; comparative notes 274).

Length of male 4.0 to 5.4 mm (based on 92 specimens); allotype male 5.0 mm. Ground color of vertex and mesonotum usually piceous, sometimes fuscous; mesonotal carinae orange. Head: Vertex relatively long and narrow, with length in middle line usually greater than width at apex of posterior emargination (length to width ratio variable from approximately 1:1 to 1.6:1); median carina absent or very short. Face usually piceous, sometimes fuscous; carinae prominent; median carina with basal fork short and moderately broad, normally percurrent and orange from base through anteclypeus; lateral carinae orange to pale yellow on frons through postclypeus, sometimes slightly expanded at epistomal suture (no maculae); frons distinctly wider than long in middle line. Rostrum short, not attaining caudal margins of posterior trochanters.

Thorax: Pronotum with intermediate carinae usually slightly separated from pale band of posterior margin. Mesonotum with carinae nearly uniform. Tegmina immaculate except slight brownish suffusion near apical crossveins; commissure pale except for brownish segment immediately basad of union of Y-veins; tubercles moderate in size and concolorous with the nearly uniform brown veins; apical cells normally 11 and anteapical cells usually 5, sometimes 6; stigma rich brown, distinct, ovoid, length two to two and one-half times width. Legs piceous or fuscous basally, mostly testaceous distally.

Male terminalia: Aedeagal complex as in figures 133 and 134; total pointed processes seven, counting the sinistral process as one. Periandrium with four processes, one of which is dorsal; dextral process rather stout, extending caudad initially, curving to the right distally, not quite reaching joint of aedeagus; sinistral process considerably less developed than in other members of Oliarus concinnulus Fowler group; distal half of sinistral process heavily spiculate; apical fourth asymmetrically bifid, the left ramus longer than the ramus that extends a short distance caudad; left branch pointed in some specimens, more rounded and thumblike in others; ventral medioapical process rather massive, avicephaliform, basal two-thirds directed caudad, apex acuminate and directed straight left. Dorsal periandrium with one prominent process inserted mediobasally and directed straight caudad, attaining level of aedeagal joint. Flagellum broadly directed to the left and with three apical or sub-apical processes, the largest one apical, unusually thick and located mostly to the dorsal surface of the flagellum; two subapical processes subequal, moderately short, opposite each other on the dorsal and ventral surfaces of the flagellum. The apices of all three flagellar processes visible ventrally, but only two visible in dorsal aspect. Styles as in figures 273 and 274; symmetrical; shaft moderately long and stout, apex well enlarged, recurved at little more than 90 degree angle, lateral margin of recurved portion subtruncate; inner processes short, broadly pointed. Connective as in figure 586; moderately short and stout, combined width of ventral arms approximately the same as width of base in posterior aspect. Pygofer as in figures 20 and 591; medioventral process in ventral view triangulate, considerably longer than wide, sides subparallel for basal half; extending posteriorly approximately half the distance to the level of the apices of the pygofer lateral lobes; lateral lobes moderately produced; in lateral aspect extending farthest caudad distinctly below midlength of posterior margins. Anal segment as in figures 512, 560, and 569; broad, the width four-fifths the length, nearly symmetrical; medioapical margin in dorsal view moderately notched (concave); in caudal view ventral profile broadly and gently concave, but straight in central portion.

Oliarus corvinus Ball is a member of the O. concinnulus Fowler group but apparently is more distantly related to concinnulus than are the other species I have included in this group. O. corvinus is best diagnosed by examining the aedeagal complex, where the sinistral process is the least developed within the concinnulus group; the thick, apical, median, ventral process is distinctive (resembling the profile of the head of a corvine bird), and the three apical and subapical processes of the flagellum have a characteristic appearance which alone is sufficient to separate corvinus from any other species. In habitus, corvinus resembles several other southwestern species. It exhibits a moderate amount of variation, including the following: the total length varies considerably; the sinistral process varies from the left ramus being pointed to being thumblike, and even to forming a comparatively deep "V" with the right ramus. This latter variation almost led Dr. J. S. Caldwell to describe a manuscript species as *O. cyclus.* Caldwell's drawings and notes, which I have on loan through the courtesy of Dr. J. P. Kramer, United States National Museum, reveal that Caldwell believed his potential new species was too near *corvinus* to permit publication; however, specimens are present in the United States National Museum and Ohio State University collections with the *"cyclus"* manuscript label.

An interesting variant of *Oliarus corvinus* was collected 65 miles south of Marathon, Texas (Big Bend National Park), 7-10-38, by R. H. Beamer (University of Kansas collection). The left-ventral process (sinistral) is wrenchlike in shape, much as in some of the Kinney County and Uvalde County, Texas specimens of *O. zyxus* Caldwell. The dorsoapical process of the flagellum is reduced in this specimen; all three flagellar processes are similar in length and thickness but still retain a characteristic *corvinus* appearance. The dextral process remains somewhat hooklike with a sharp apical curve to the right, and the other processes are fairly typical except the ventromedioapical process is not as thick as usual for *corvinus*.

The type series of *Oliarus corvinus* Ball is mixed. The insect pin with the holotype label has a cardboard point with three females glued to it and no indication which of the three is the holotype. The allotype pin has three males glued to the point with no indication which of the three is the allotype. Ball (1934) in the original description listed the holotype female, allotype male, and 12 paratypes as the type series, all from Patagonia, Arizona, August 8, 1932 (E. D. Ball). I have seen this type series in the United States National Museum, except for a few paratypes. Two pins having label data exactly matching that of the holotype are in the National Museum but are without paratype labels. Each one of these pins has three specimens glued to the point. At least two of the paratype pins are marked with blue "E. D. Ball" paratype labels. The holotype and allotype pins are marked with red "E. D. Ball" labels. I have examined the three males on the point attached to the pin with the allotype label. The specimen on the tip of the point is not corvinus but O. zyxus Caldwell. I have glued it to another point and relabeled it, including information that it originally was on the corvinus allotype point. It carries the label of F. W. Mead Specimen Number XII-6671. Also on the allotype point is another specimen of zyxus. This individual is next to the pin, leaving the middle specimen as the only one of the original three as actually corvinus as interpreted here. The dissected abdomens of these two specimens remaining on the allotype point have been placed together in the microvial on the pin. Comparison of the drawings for corvinus and zyxus serve to distinguish the two. F. W. Mead Specimen Numbers XII-6672 and XII-6673 have been placed on the pin, with XII-6672 referring to the middle specimen.

From the standpoint of nomenclatural stability it is essential to know if the three females on the holotype pin are all Oliarus corvinus Ball, and if not, which particular specimen was meant to be the standard bearer. Since two of the three males on the allotype pin were O. zyxus Caldwell, the possibility must be considered that at least one of the three females on the holotype pin is zyxus. I examined these three females somewhat superficially on a visit to the United States National Museum. The general appearance of the three was about the same. The specimen on the tip of the point was smaller, having a head width of 1.04 mm and a total length of 5.5 mm. The middle specimen had a head width of 1.17 mm and length of 6.2 mm. The specimen next to the pin had a head width of 1.16 mm and a length of 6.4 mm. The middle specimen probably would be best to designate as lectotype but until the females are better understood, it probably is best to postpone a lectotype designation for this species. It seems clear from most of the type series, the original description, and the *corvinus* unit tray in the National Museum filled with E. D. Ball specimens, that it was Ball's intent for the name *corvinus* to be applied to the species concept as here interpreted.

Caldwell, the major worker on North American *Oliarus* since Ball, apparently used the same concept of *corvinus* Ball as used here. At least, the *corvinus* unit trays at Ohio State, which were determined almost exclusively by Caldwell, are nearly all *corvinus* as interpreted herein. Furthermore, Ball and Caldwell applied *corvinus* almost strictly to Arizona specimens. If the determinations of *corvinus* had been meant for what is now *O. zyxus* Caldwell, specimens from Mexico to Canada would have had the *corvinus* determination label on them. In comparing a series of female *corvinus* with a series of female *zyxus*, it is obvious that *corvinus* averages larger, but there is some overlap in size.

In the original description of *Oliarus corvinus*, Ball made several comparisons of *corvinus* with *O. complectus* Ball as redefined in the same paper. Ball did not give the geographic locality of the complectus he was using for comparison, so these comparisons may be to complectus in the strict sense, or it may have been to complectus in the broader sense which would have included the present species O. viequensis Caldwell and O. acicus Caldwell. O. corvinus is a southwestern United States species so Ball probably was making comparisons with his southwestern forms of "complectus" which really are acicus. Ball listed the length of corvinus as 5 - 6 mm saying it "is easily distinguished by its size." O. corvinus does average a little larger than some of the other similar southwestern species, but males are available that barely extend over four mm in total length, which puts corvinus in the size range of many species. There was a tendency for the Texas and California specimens to be smaller than the Arizona individuals.

Specimens of Oliarus corvinus Ball examined included a few more than 200 individuals of both sexes. Some of these had been determined as corvinus by previous workers but were found to be something else on close inspection. In major museums I have discovered corvinus erroneously determined as, "conconinus", franciscanus, californicus, coconinus, zyxus, yavapanus, bispinus, and catus.

Oliarus corvinus Ball is a member of the O. concinnulus Fowler group. This is a difficult, highly variable group which includes seven species as here treated. O. corvinus seems to be one of the most distinct, if not the most distinct, species in the group. It probably is closest to some of the Texas forms of O. zyxus Caldwell.

The range of Oliarus corvinus Ball was stated as "widely distributed in southern Arizona" in the original description. I now add the states of Texas and California. In Texas it seems restricted to the Davis and Chisos Mountain areas of Davis and Brewster Counties, respectively. In Arizona I have seen specimens from numerous localities in Cochise, Coconino, Graham, Mojave, Pima, Pinal, and Yavapai Counties. In California the localities are scattered in Inyo, Riverside, and San Diego Counties.

Habitats seem to be primarily in mountainous areas according to the locality labels of determined males. Altitude labels of 5800, 3600, 3700, 4150, 4600, and 6300 feet were on Oliarus corvinus Ball specimens, with the lowest of 3600 feet occurring near Kits Peak, Baboquivari Mountains, Arizona, the highest of 6300 feet occurring nine miles northeast of Big Pine, Inyo County, California. "Host" plants on the labels of corvinus males include, "on Acacia greggii" [Gray], "ex Solidago wrightii" [Gray], and "sapind." The latter presumably is an abbreviation of Sapindus, the generic name of soapberry.

One specimen out of nearly 200 examined had a parasite attached to the abdomen.

Seasonal distribution, as determined from the available specimens, extends from April 28 to October 5, with peak numbers apparently occurring during midsummer.

OLIARUS LITTORALIS BALL

Figures 21, 135, 136, 145, 146, 513, 561, 570, 587, 592

Oliarus littoralis Ball, 1934. J. Wash. Acad. Sci. 24:274-275 (Key 270-271).

Oliarus littoralis; Caldwell, 1947. Ohio J. Sci. 47:77 (Comparative notes).

Length of male 4.0 to 4.7 mm (based on 55 specimens); allotype male 4.5 mm. Ground color of vertex and mesonotum fuscous; mesonotal carinae testaceous. Head: Vertex narrow, distinctly longer in middle line than wide at apex of posterior emargination; median carina absent. Face usually fuscous, occasionally fusco-testaceous; median carina prominent, percurrent, weakly forked at base, yellowish entire length; lateral carinae conspicuously pale yellow on frons and postclypeus, pale border slightly broader on frons; frons moderately narrow, width slightly but consistently greater than length in middle line. Rostrum short, seldom reaching posterior trochanters.

Thorax: Pronotum with intermediate carinae not joining pale band of posterior margin. Mesonotum with carinae usually equally prominent. Tegmina with spotting confined to suffusion at apical crossveins and at commissure immediately basad of Y-vein junction; tubercles moderately prominent, brownish; veins tending to be testaceous basally, brown apically; apical cells normally 11 and anteapical cells 6; stigma brown, rounded, length approximately twice the width. Legs not banded.

Male terminalia: Aedeagal complex as in figures 135 and 136; total pointed processes eight or nine depending upon interpretation of structures. Periandrium with five or six pointed processes; dextral process long and slender, its apex usually most posterior part of aedeagal complex, apex curved to right, acute; sinistral process an enlarged, complex structure generally extending left-caudad; basal median portion of sinistral process developed into a prominent, fairly slender, acute subprocess extending slightly right-caudad; apex of sinistral process thick and curved slightly right-caudad, parallel to basal subprocess, thereby forming caliperlike structure, with interior margin between "caliper" points greatly expanded, forming a strong convexity; spicules common on much of basal half of sinistral process; ventroapical part of periandrium with a long, moderately slender process curving to the left; dorsal periandrium with slender, straight, moderately long process originating mediobasad, apex ending approximately at level of aedeagal joint; left apical dorsal periandrium with short, inconspicuous process directed primarily to the left. Flagellum broadly developed to the left and with three unequal processes in the apical area, best seen dorsally. Styles as in figures 145 and 146; symmetrical or nearly so; shafts broader basally, abruptly narrowed near midlength; apices rounded and recurved; inner processes short, broadly pointed. Connective as in figure 587; moderately stout; combined width of ventral arms slightly broader than base of shaft in posterior aspect. Pygofer as in figures 21 and 592; nearly symmetrical; medioventral process in ventral aspect triangular, longer than broad, acute, widest at or near base; extending posteriorly approximately half the distance to level of apices of pygofer lateral lobes; lateral lobes stout in ventral view;

in lateral aspect well produced, apices rounded to obliquely subtruncate. Anal segment as in figures 513, 561, and 570; in dorsal view nearly symmetrical, longer than wide, but fairly broad; medio-apical margin slightly concave; in caudal view hoodlike; middle portion broadly, deeply, and subrectangulately emarginate.

Oliarus littoralis Ball is a member of the O. concinnulus Fowler group, and seems closest to O. zyxus Caldwell. Diagnostic characters of littoralis include the prominent introrse convexity on the median part of the sinistral process and the broad, deep, rectangulate excavation of the anal segment as seen in posterior view.

In southern Florida Oliarus littoralis Ball is typical of the same grassy tidal flat situations as is O. viequensis Caldwell. Sometimes the two species are taken together in the collecting samples. Male genitalia of the two species are vastly different, but the habitus is similar. Males of the two species can be separated without dissections. O. littoralis is usually larger, ranging 4.0 to 4.7 mm. whereas viequensis ranges 3.2 to 4.1 mm in total length; littoralis usually is a tawny brown, viequensis usually is black, occasionally fuscous; littoralis normally has six anteapical cells in the tegmen, viequensis five; the apex of the anal segment of littoralis is concave, without a tooth or process, whereas the apex of the anal segment of viequensis has a deflexed, acute, apical tooth or process.

Ball listed the holotype female, allotype male, and seven pairs of paratypes of Oliarus littoralis Ball taken by him at Tampa, Florida, September 10, 1927. I have seen all the type material at the United

States National Museum with the possible exception of a few paratypes. The allotype male was on the tip of the point containing two female specimens, one of which is the type. I removed the allotype and remounted it on a separate point.

Other specimens examined were all from Florida, leading to the conclusion that Oliarus littoralis Ball is endemic to Florida. It is a common species in localized situations, and apparently most abundant in the Florida Keys. Ball (1934) said he collected littoralis "in a number of places along the east coast of Florida." I have not discovered his specimens or any others which were collected on the east coast of Florida and are littoralis.

At least some, if not all, of Ball's east coast Oliarus littoralis are O. viequensis Caldwell. Males of viequensis collected by Ball in Daytona and New Smyrna, Florida, were discovered in the littoralis unit tray at the United States National Museum. The Florida distribution of littoralis by counties is: Dade County: Everglades National Park, Homestead; Hillsborough County: Tampa; Levy County, Cedar Keys; Monroe County: Big Pine Key, Conch Key, Duck Key, Grassy Key, Greyhound Key, Key Largo, Key Vaca, Lower Matecumbe Key, Stock Island, and Garden Key (of the Dry Tortugas Islands, 60 miles west of Key West); Sarasota County: Venice.

Oliarus littoralis Ball is the only species of the O. concinnulus Fowler group which has been collected east of Texas. Within the group, littoralis apparently is closest to O. zyxus Caldwell, specimens of which have been taken at several places along the Gulf Coast of Texas as well as many other locations in western North America.

Oliarus littoralis Ball is typical of tidal flat situations where salt-marsh grasses predominate. Circumstantial evidence points to littoralis using these grasses as host plants, with the nymphs presumably feeding on roots. O. littoralis sometimes is associated with O. viequensis Caldwell in the Florida Keys, at least; however, at any one habitat or collecting spot there is a distinct tendency for one species to greatly predominate over the other or be unique. It has been my collecting experience that viequensis is more abundant in the Monanthochloe littoralis Engelm. grassy tidal flats, and that littoralis is more abundant in the tidal flats where taller saltmarsh grasses such as Distichlis spicata (L.) Greene or Sporobolus virginicus (L.) Kunth. predominate. Further investigations are needed to corroborate and add to these observations and to gain a better understanding of the many factors involved.

OLIARUS SYLVATICUS CALDWELL

Figures 22, 137, 138, 147, 148, 514, 562, 571, 588, 593

Oliarus sylvaticus Caldwell, 1947. Pan-Pac. Ent. 23:151.

Length of male 3.5 to 4.0 mm (based on three specimens). Ground color of vertex and mesonotum fuscopiceous; carinae of mesonotum varying from brown to dull orange and brownish yellow. Head: Vertex moderately narrow, length in middle line greater than width at apex of posterior emargination; median carina short. Face fuscous to fusco-piceous; lateral carinae narrowly pale yellow on frons, becoming dull on postclypeus; median carina yellowish brown, weakly forked at base, prominent on frons, evanescent slightly distad from median ocellus; frons wider than length in middle line. Rostrum short, failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae narrowly failing to join pale border of posterior margin. Mesonotum with carinae equally prominent or nearly so. Tegmina milky subhyaline; clavus without spots; corium with brownish suffusion at crossveins r-m and m-cu and at apical crossveins; tubercles comparatively large, dark brown, blending with dark veins; usually with 11 apical cells and 5 anteapical cells; stigma brownish, approximately twice as long as broad. Legs brown to yellowish without bands.

Male terminalia: Aedeagal complex as in figures 137 and 138; total pointed processes seven. Periandrium with four processes; dextral process entire, extending caudad to level of aedeagal joint, fairly straight except curving right at apex; sinistral process large, directed left-caudad, inner subapical portion triangulately produced and directed to the right, no inner subprocess, spicules common on basal half of process; median apical area with long slender curving process primarily directed to the left; dorsally with long slender process inserted basally, directed caudad primarily, and extending to, almost to, or slightly beyond basal posterior margin of flagellum. Flagellum with three moderate-sized apical processes of fairly equal length, the apical parts of all three visible from either dorsal or ventral view. Styles as in figures 147 and 148; symmetrical or nearly so, rounded and recurved apically; inner processes short, pointed. Connective as in figure 588; rather slender, combined width of ventral arms slightly greater than width of base in posterior aspect. Pygofer as in figures 22 and 593; medioventral process in ventral aspect short, triangular, broadest at base, extending posteriorly less than half the distance to level of apices of pygofer lateral lobes; pygofer lobes in ventral aspect slightly diverging; in lateral aspect symmetrical or nearly so, lateral margins broadly rounded caudally. Anal segment as in figures 514, 562, and 571; in dorsal aspect nearly symmetrical, flaplike, moderately broad, longer than wide, medioapical margin straight or slightly concave; in caudal view nearly symmetrical, ventral profile nearly straight, slightly concave.

Oliarus sylvaticus Caldwell is apparently a rare member of the O. concinnulus Fowler group. It is very close to an atypical form placed under O. zyxus Caldwell below. Possibly future studies will show that one or two of the variations included under zyxus should be placed under sylvaticus, or that sylvaticus should be synonymized under _zyxus_ as one of its many variations. A principal difference between _sylvaticus_ and _zyxus_ is in the shape of the sinistral process. The apical part is shaped differently, and the inner basal part in _sylvaticus_ lacks the toothlike subprocess present in nearly all variations of _zyxus_ and in other species of the _concinnulus_ group. The dorsal periandrial process of _sylvaticus_ is longer and straighter than normally present in the other species of the _concinnulus_ group.

The type series listed by Caldwell was "male holotype and paratype, and female allotype from Oak Grove, California, June 3, 1946 (D. J. and J. N. Knull), OSU" [Ohio State University]. At Ohio State I examined the holotype male (slightly damaged), allotype female, and a paratype female.

Other specimens examined included a male from Boulevard, California, VI-12-51 (D. J. and J. N. Knull) Ohio State University collection, and a male from San Diego, California, 6-7-13 (E. P. Van Duzee) California Academy of Sciences collection (previously determined as _Oliarus concinnulus_ Fowler).

Professor Emeritus J. N. Knull of Ohio State University informed me (personal correspondence Dec. 1967) that Oak Grove is in northern San Diego County, California, on state route 79, not too far from Palomar Observatory. Oak Grove is immediately east of Cleveland National Forest. Professor Knull indicated that desert oaks were typical of the habitat where he collected _Oliarus sylvaticus_. The other localities for _sylvaticus_ are also in San Diego County, California; thus, the range of _sylvaticus_ appears very limited.

The collections of _Oliarus sylvaticus_ Caldwell have all been in early June (June 3, 7 and 12).

OLIARUS ZYXUS CALDWELL

Figures 24, 151-176, 564, 573, 574, 595

Oliarus zyxus Caldwell, 1947. Ohio J. Sci. 42:76-77.

Length of male 3.4 to 5.3 mm (based on 130 specimens). Ground color of vertex piceous to fuscous, mesonotum usually piceous, but some specimens fuscous, or even mixed with testaceous; mesonotal carinae variable in color but usually dull orange or yellow-brown, occasionally concolorous, in various degrees, with intercarinal areas of mesonotum. Head: Vertex narrow to moderately broad, usually narrow, with length in middle line usually distinctly greater than width at apex of posterior emargination; some specimens having width as great as length or even slightly greater; median carina absent or very short. Face usually fuscous but variable from fusco-piceous on one extreme to yellowish brown on the other; median carina, with few exceptions, prominently traversing whole face, yellowish, weakly forked at base; lateral carinae prominent pale yellow from base to apex of postclypeus, broader on frons, especially at epistomal suture; frons moderately broad, width greater than length in middle line. Rostrum short, failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae narrowly separate or occasionally tangential to pale band of posterior margin. Mesonotum with all carinae prominent. Tegmina without prominent spots or bands; apical crossveins usually weakly infuscate, commissure with usual dark area basad of Y-vein juncture; tubercles not prominent; veins usually a fairly uniform light brown; apical cells normally 11 and anteapical cells 5 or 6; stigma roundish, approximately twice as long as wide. Legs without banded pattern.

Male terminalia: Aedeagal complex as in figures 165 and 172; total pointed processes seven to nine, depending upon variation and interpretations. Periandrium with at least four, sometimes five processes, counting the sinistral process as one; dextral process prominent, varying from medium-sized, straight and stout, to long, variously curved, and moderately slender; sinistral process variously expanded to the left, the caudal margin usually excavate between two pointed or semipointed expansions, thus forming a crude outside "caliper-shaped" process; shape of sinistral process highly variable as shown in figures 153 to 176; spicules usually abundant on ventral surface of basal half of sinistral process; medioapical area of ventral periandrium with prominent process curving to the left, varying from uniformly slender in some specimens to combination of slender and stout in other specimens; dorsal periandrium with a mediobasal process extending primarily caudad, usually making slight bend to the left in distal half, and superimposed over the aedeagal apodeme, with apex of process usually slightly surpassing level of aedeagal joint, left apical area of dorsal periandrium without a short pointed process in most specimens but with such a process in minority of specimens. Flagellum directed to left and with three processes in the apical and subapical area; shortest of these processes variously located in the subapical dorsal side of the flagellum and directed cephalad; all three flagellar processes somewhat variable in length and shape, although consistent in being fairly slender. Styles as in figures

151 and 152; symmetrical, rather long, recurved apically, and with inner processes short and pointed. Connective as in figures 510; moderately long and slender; combined width of ventral arms equal or nearly equal to the width of the base in posterior aspect. Pygofer as in figures 24 and 595; symmetrical or nearly so; medioventral process in ventral aspect longer than wide, acute, rather short, triangulate, widest at base in some specimens, slightly constricted at base in other specimens; extending posteriorly approximately half the distance to level of apices of pygofer lateral lobes; lateral lobes stout in ventral aspect, moderately produced and rounded in lateral aspect. Anal segment as in figures 564, 573, and 574; in dorsal view nearly symmetrical, rather broad, but with length exceeding width in nearly all specimens (an occasional specimen with width equal to length); medioapical margin straight or slightly concave; apex in caudal view with ventral profile slightly concave and sinuate but primarily fairly straight.

Oliarus zyxus Caldwell is a member of the O. concinnulus Fowler group and is one of the most common and widespread species in western North America. It is also one of the most variable species, and future studies may demonstrate that forms included here as variants of zyxus are in reality separate species. The presence of certain intermediate specimens, the lack of biological data, and the paucity of specimens in certain variant groups are reasons for not proposing new taxa in the zyxus complex of forms at this time.

Previous workers have included Oliarus zyxus Caldwell under several other species concepts. For example, the original type series of O. complectus Ball contained a male zyxus collected at Phoenix, Arizona, May 1897; two males from Los Angeles County, California, formerly in the Coquillett collection and now in the United States National Museum have old determination labels of Myndus atritus Uhler. I have seen other specimens of O. zyxus determined as O. concinnulus Fowler, O. dondonius Ball, O. franciscanus (Stål), and less commonly as certain rare western species.

Superficially, Oliarus zyxus Caldwell resembles all the other members of the O. concinnulus group plus several other moderately small species of Oliarus of the southwestern United States and northern Mexico. O. zyxus can be distinguished from the very close O. sylvaticus Caldwell by the shape of the sinistral process; O. concinnulus Fowler and O. altanatus Caldwell have extremely slender dextral processes not found in any of the zyxus variants and have differently shaped sinistral processes which normally lack spicules that are always present in the forms I interpret as zyxus. O. littoralis Ball has an extreme convexity or "hump" on the margin of the sinistral process which I have not seen developed to this degree in zyxus. O. littoralis has a unique apex of the anal segment and apparently is endemic to Florida. O. corvinus Ball differs from zyxus by the reduced size and different shape of the sinistral process, the shorter, stouter, and differently located apical and subapical processes of the flagellum, and the very stout medioapical process of the ventral periandrium. O. dondonius Ball is the species most often having forms resembling zyxus, but dondonius has a preapical flagellar process that is different in shape and position from its counterpart in zyxus, the process being unusually short and directed primarily to the left or left-caudad from its base on the left caudodorsal position of the flagellum in dondonius. In zyxus this flagellar process is longer, directed cephalad, and is not inserted at the extreme left-caudodorsal position. In most specimens of dondonius the sinistral process has a very characteristic deeply U-shaped excavation in which the cavity is deeper than the distance across the opening as viewed in ventral aspect, a condition not approached by zyxus except in some of the uncommon variants. All specimens presently interpreted as zyxus have at least a few spicules on the sinistral process. I have not found spicules on the sinistral process of dondonius.

The variations so prevalent in Oliarus zyxus can be associated with geography to a considerable extent. Specimens with the forked subprocess of the sinistral process (figures 173 and 176) apparently are restricted to the Gulf Coast of Texas from Brownsville, Cameron County, to Cedar Lake, Matagorda County. Specimens with a wrench-like sinistral process (figures 166 and 175, seem restricted to southern Texas, the records so far being from Lake Corpus Christi and the counties of Kinney, Uvalde, and Val Verde. Sinistral processes of approximately the form exhibited in the type series (figure 165) are the most prevalent and have been seen by me in specimens from the Texas counties of Medina, Terrell, Val Verde, Webb, and Zavalla; the New Mexico counties of Chaves, Eddy, Hidalgo, Otero, Socorro, and Valencia; the Arizona counties of Cochise, Maricopa, Pima, Santa Cruz, and Yavapai; the Utah County of Sevier, and the

California counties of Inyo, Orange, San Diego, and Ventura. Specimens from Craig, Moffatt County, Colorado and Benjamin, Utah County, Utah, have long, twice-curved dextral processes and uaually have sinistral processes produced at both the inner and outer angles of the apex (figures 155 and 156). Other variations of the sinistral process not far removed from those of typical forms include forms from Clarion, Idaho, (figure 154); Deep Spring, Inyo County, California (figure 174); Carson City, Ormsby County, Nevada (figure 157), and 11 miles north of Nixon, Washoe County, Nevada. Forms from Los Angeles County, California (figures 167 and 170) have the right basal portion of the sinistral process swollen. Another type of sinistral process shown in 168 and 164 is present, with slight variations, on specimens from Del Puerto Canyon, Stanislaus County, California; Palm City, San Diego County, California and San Blas, Nayarit, Mexico. This is one of the most distinctive variant forms. Yet another form, in which variation of the sinistral process possibly is discontinuous, is shown in figures 159 and 163 (sinistral process). This particular form is represented by four male specimens collected one mile north of McKittrick, Kern County, California, April 16, 1966, by C. W. O'Brien, on Atriplex spinifera Macbride, and by one male from Los Angeles, California, in the P. R. Uhler collection in the United States National Museum. A specimen from Isla Raza, Gulf of California, Mexico, has a sinistral process slightly different from United States forms. Specimens from Shasta County, California (figure 160); Medford, Jackson County, Oregon (figure 156); and Vernon, British

Columbia, Canada (figure 153) exhibit considerable similarity in their sinistral processes as well as in other structures.

Another variable structure in Oliarus zyxus Caldwell is the short, acute process located at the left apex of the dorsal periandrium of some specimens. Most specimens lack this short process, but when present it usually extends dorsally or toward the left.

Caldwell (1947a) listed the male holotype of Oliarus zyxus and a paratype from Nuevo Laredo, Nuevo Leon, Mexico, September 22, 1941 (DeLong, Good, Caldwell, and Plummer). Another male paratype was collected at Torreon, Coahuila, Mexico, "(M B 237, Dampf)." I have seen all three of these specimens in the United States National Museum. The Nuevo Laredo types have the additional information "30 miles south" on the locality label. "Dampf" is not on the collector label of the other paratype; apparently Caldwell recognized A. Dampf as the collector by the style of the label.

Oliarus zyxus Caldwell is a member of the O. concinnulus Fowler group, with O. concinnulus apparently confined to Mexico and distinct from zyxus, although very similar. O. zyxus seemingly is a very plastic species and has radiated throughout much of western North America, exhibiting a variety of forms often tending to be correlated with a particular region. Its range has been discussed above in connection with morphological variation. To summarize, zyxus has been collected in the following areas: CANADA: British Columbia; MEXICO: Coahuila, Nayarit, Nuevo Leon, and a few islands in the Gulf of California; UNITED STATES: Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Texas, and Utah.

Habitat and host labels on specimens of _Oliarus zyxus_ Caldwell include: "sweeping grass," "_Carex_ sp.," "_Baccharis sergiloides_" [Gray], "_Monarda citriodora_" [Cerv.], "at night on _Atriplex spinifera_" [Macbride], "at blacklight."

The known seasonal distribution of _Oliarus zyxus_ extends from March 25 to November 27, but only two records are available for October and November.

OLIARUS DONDONIUS BALL

Figures 23, 28, 139, 140, 141, 142, 149, 150, 515, 563, 572, 589, 594

Oliarus dondonius Ball, 1934. J. Wash. Acad. Sci. 24:276 (Key 270-271; Comparative notes 275).

Oliarus dondonius; Caldwell, 1951. Ohio J. Sci. 51:35 (Comparative notes).

Length of male 3.6 to 4.7 mm (based on 103 specimens). Ground color of vertex and mesonotum highly variable, from ochraceous at one extreme through various shades of brown to fuscopiceous on the other extreme; mesonotal carinae varying from pale yellow to yellow-brown. Head: Vertex as in figure 28; narrow to broad, usually distinctly longer in middle line than wide at apex of posterior emargination, but some specimens with width greater than length; median carina feeble. Face varying from ochraceous to fuscopiceous; median and lateral carinae conspicuous and broadly pale yellow on frons, less so on postclypeus; median carina weakly forked at base, extending through anteclypeus; frons moderately broad, width greater than length in middle line. Rostrum short, not attaining caudal margin of posterior trochanters.

Thorax: Pronotum as in figure 28; intermediate carinae tangential to or joining pale border of posterior margin. Mesonotum as in figure 28; carinae usually equally prominent. Tegmina with dark areas confined to narrow infuscation along apical crossveins, to crossveins r-m and m-cu, and to a short distance along commissure immediately basad of Y-vein juncture; tubercles not prominent, usually concolorous with veins which tend to be pale yellow or light brown on basal half to two-thirds of tegmen, medium to dark brown in apical area; apical cells normally 11 and anteapical cells 5; stigma variable from pale yellow to medium brown, its length a little more than twice the width. Legs unbanded.

Male terminalia: Aedeagal complex as in figures 139-144; total pointed processes eight or nine depending upon variation and interpretation of structures. Periandrium usually with four processes, occasionally with an extra dorsal process; dextral process entire, comparatively short (not surpassing level of aedeagal joint), usually fairly straight except some specimens with apex curved somewhat; sinistral process greatly expanded left-caudad into a cheliform process with long axis of concavity usually directed approximately 45 degrees right-caudad; apical prong much thicker than basal prong or subprocess; basal prong usually straight, occasionally curved, sometimes slightly serrate or crenulate along right basal area; concavity deeper than distance between apices of "jaws"; without spicules; medioventral area of periandrium giving rise to a thick process directed to the right initially, then recurving to a left-caudad direction primarily and becoming long and slender; dorsal periandrium with a moderately stout, fairly straight process originating mediobasally and extending superimposed over apodeme of aedeagus to level of joint of aedeagus; left apical periandrium without short process in most specimens, but occasionally with a short, pointed process. Flagellum directed to the left and with two similar medium-sized apical processes directed cephalad, the more dorsal process somewhat larger and longer; left, dorsal subapical area of flagellum with a short, slender, acute process which is normally directed left or left-caudad; a lightly sclerotized, short, toothlike process occurring occasionally on the apical membranous part of the flagellum tending to be directed right-cephalad, usually hidden from view by overlying processes; occasionally a very short, broadly pointed, cryptic process present in the left dorsal area of the flagellum, hidden from direct ventral or dorsal view (thus flagellum with at least three fairly conspicuous processes and sometimes with one or two other short, cryptic processes). Styles as in figures 149 and 150; symmetrical or nearly so; shafts broader basally, abruptly thinner near midlength of inner margin; apex enlarged and recurved; inner processes short and pointed. Connective as in figure 589; moderately long and slender; combined width of ventral arms greater than width of base in posterior aspect. Pygofer as in figures 23 and 594; symmetrical; medioventral process in ventral aspect subtriangular, longer than wide, not or very slightly constricted at base; process extending posteriorly approximately half the distance to level of apices of pygofer lateral lobes; lateral lobes thick in ventral aspect, moderately produced and rounded in lateral view. Anal segment as in figures 515, 563, and 572, in dorsal aspect nearly symmetrical, rather short and broad, length but little greater than the width; medioapical margin variable, sometimes slightly convex, usually slightly concave; in caudal aspect the ventral profile normally straight or nearly so.

Oliarus dondonius Ball is a member of the *O. concinnulus* Fowler group. In the past, it has not only been confused with other members of this group, but has been determined rather commonly as *O. franciscanus* (Stål) and *O. complectus* Ball, and much less often as *O. altanus* Ball or other western species in North America. Superficially, ochraceous colored specimens of *dondonius* resemble specimens of *O. sementinus* Ball, but the latter has a looping flagellum characteristic of the *O. aridus* Ball group, which is different from that in *dondonius*; *sementinus* lacks the two pronged large sinistral process of *dondonius*; the vertex of *sementinus* is usually much broader, and the facial carinae of *dondonius* are prominently elevated and pale colored, whereas they are nearly obsolete in *sementinus*. *O.* ~~*franciscanus*~~ and *complectus* have been redefined and are completely different and remote geographically from *dondonius*. Within the *concinnulus* group, *dondonius* apparently is closest to *O. zyxus* Caldwell, under which differences between the two species are discussed. Probably the two most distinctive characteristics separating *dondonius* from the other members of the *concinnulus* group are the greatly enlarged, deeply and rather narrowly excavate, cheliform sinistral process of the periandrium and the short, left-directed, preapical process of the flagellum.

Variation in *Oliarus dondonius* Ball is common. In addition to that already mentioned, the interior margin of the U-shaped excavation of the cheliform process occasionally has one or two short teeth. Also, it is reemphasized that in habitus *dondonius* varies from a rusty ochraceous color to dark brown or black.

Ball listed the type material as follows: "Holotype female, allotype male, and 10 paratypes, Tucson, Ariz. July 24, 1930, 4 paratypes, Grand Junction, Aug. 7, 1906, all taken by the writer on sea blite (Dondia)." This type material is in the United States National Museum but some of the apparent paratypes were discovered unmarked, as such, in the line collection. Specimens of O. dondonius in a unit tray (collected by E. D. Ball) contained the following apparent, non-marked paratypes: three females, four males, all labeled "Grand Juc. Col. 8-7-06"; one male, one female "Tucson, Ar. 7-24-30 E. D. Ball." The "Grand Juc. Col." is an abbreviation for Grand Junction, Colorado. The pin with the red holotype label has three specimens on the cardboard point. The specimen on the tip is a male, the other two are females. The pin with a red allotype label has three specimens on the paper point, a female next to the pin, a male at the apex and another male between. A pin with a blue paratype label has two specimens on the paper point, a female next to the pin, a male on the apex. I have assigned F. W. Mead Specimen No. XII-6678 to this male. Another pin with a blue paratype label has only a male at the apex of a paper point. This specimen was given F. W. Mead Specimen Number I-23656. It is the principal specimen illustrated in the present redescription.

The range of Oliarus dondonius Ball is much the same as O. zyxus Caldwell, which is a common, closely related species. O. zyxus has been collected in Idaho and three states in Mexico for which I have no record of dondonius. O. zyxus is common in Texas, but dondonius apparently is scarce, since I have seen only a few specimens from west Texas in the various collections.

The range of Oliarus dondonius Ball, as determined by specimens seen by me, is as follows: CANADA: Alberta, Manyberries; British Columbia, Osoyoos. MEXICO: Gulf of California and Baja California, Mulege, San Francisco Island, San Lorenzo Island, and Santa Inez Island. UNITED STATES: Arizona, California, Colorado, Nevada, New Mexico, Oregon, Texas, Utah.

Ball (1934) wrote that Oliarus dondonius "is common in alkaline areas from western Colorado through Utah to Arizona and Sonora, Mexico." Host or habitat labels on male O. dondonius determined by me include the following: "Atriplex bracteosa" [(Durand and Hilgard) Watson; =A. serenana A. Nelson]; "Atriplex hastata L.";"Atriplex rosea L."; Atriplex torreyi S. Wats."; "black sage" [presumably Artemisia nova]; "collected on cotton" [Gossypium sp.]; "on corn" [Zea mays Linnaeus]; "Dondia"; "Dondia spp."; "Dondia nigra" [(Raf.) Standl.; = Suada nigra (Rafinesque) MacBr.] "Houstonia"; "potato" [Solanum tuberosum Linnaeus]; "Salicornia"; "Salsola pestifer" [Nelson]; "swept from rice" [Oryza sativa Linnaeus].

The earliest known collecting date for Oliarus dondonius Ball is March 27, and the latest is September 15.

OLIARUS SABLENSIS CALDWELL

Figures 112, 113, 253, 254, 354, 415, 416, 457, 502, 552, 576

Oliarus humilis (Say); Hendrickson, 1930. Iowa St. Coll. J. Sci. 4:88. Misdetermination.

Oliarus ecologus Caldwell; Beirne, 1950. Can. Ent. 82:93-95; illus. Misdetermination.

Oliarus sablensis Caldwell, 1951. Ohio J. Sci. 51:34-35.

Length of male 3.4 to 4.4 mm (based on 85 specimens). Ground color of vertex, mesonotum and face fuscous in most specimens, occasionally piceous or fuscocastaneous; mesonotal carinae usually concolorous, occasionally a contrasting orange. Head: Vertex elongate, length in middle line greater than width at apex of posterior emargination; width approximately five-sixths the length; median carina absent or very short. Face fuscous to piceous, with median carina orange, yellow or brownish yellow and well elevated throughout its length, the basal fork small; lateral carinae usually pale yellow to brownish yellow, usually conspicuous throughout length; maculae absent; frons narrow, width only slightly greater than length in middle line. Rostrum short, failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae usually narrowly separated from pale border of posterior margin. Mesonotum with prominent carinae, the intermediate pair less distinct. Tegmina usually nearly immaculate, some specimens slightly infuscated at apical crossveins and numerous specimens with tegmina presenting a vague dusky appearance; tubercles not prominent, concolorous with yellowish to light brown veins which become darker brown apically; apical cells normally 10 and anteapical cells 5, variation fairly common; stigma medium brown, short, with length one and one-half times to twice the width.

Male terminalia: Aedeagal complex as in figures 112 and 113; total pointed processes eight (but differences in interpretation or counting of adventitious subprocess could change total from seven to nine). Periandrium with six processes, not counting adventitious subprocesses; dextral process usually long, extending caudad past aedeagal joint, tapered, fairly straight, usually curving to the right apically, in a few specimens unequally forked in distal third, with this fork or subprocess developing right-laterad; sinistral process somewhat shorter than the dextral process; swollen or undulate in most of basal two-thirds, narrowed apically, apex uncinate, usually curving 90 degrees to the left; median ventroapical area giving rise to moderately prominent process which curves left-cephalad after initial caudal direction, this process variable, distal half in some specimens fairly straight, in others continuously curving; inner left apical area giving rise to a fairly straight, tapering, acuminate, left-directed process, usually extending left to level of apex of flagellum; dorsal periandrium with prominent sclerotized plate giving rise to two pointed processes, the larger one extending caudad and curving to the left, the smaller one directed right-laterad; processes somewhat variable. Flagellum directed to the left and with two processes, one of which is ventrobasal, generally slender, highly variable in length, the other apical and variable in length and quite short in a few specimens. Styles as in figures 253 and 254; apex of each shaft rounded and recurved at approximate 125 degree angle, apex of recurved portion bluntly rounded; inner processes rather short, broadly pointed. Connective as in figure 576; moderately slender; combined width of ventral arms slightly broader than base of shaft in posterior aspect. Pygofer as in figures 354, 415, and 416; medioventral process in ventral view somewhat ovate, slightly constricted at base, apex broadly pointed; extending posteriorly more than half the distance to level of apices of pygofer lateral lobes; lateral lobes moderately produced, apices broadly rounded, nearly symmetrical. Anal segment as in figures 457, 502, and 552; in dorsal view symmetrical, short and broad, the width in most specimens almost as great as the length; medioapical margin nearly straight, usually slightly concave; in caudal aspect ventral profile slightly concave.

Oliarus sablensis Caldwell is a member of the group that contains *O. bispinus* Caldwell and *O. chuliotus* Ball. I can separate these three species by the aedeagal complex only, as discussed under *chuliotus* of the *chuliotus* group. *O. sablensis* is so close to *chuliotus* that I can separate the two only by the presence or absence of the apical process on the flagellum. *O. sablensis* has a distinct process in most specimens but some of the examples from Ohio and New York, for instance, have much reduced apical processes. I have yet to see a specimen in the southern United States with a really short apical process. At Gainesville, Florida, I collected and examined a long series of *sablensis* and found that the apical process of the flagellum was always well developed. Proper interpretation of the shorter apical flagellar process is difficult. It does not appear to be clinal, since specimens from such cool climates as Cades Cove, Great Smoky Mountains, Tennesse: LeSeuer County, Minnesota: and Kings County, Nova Scotia, all have a well developed apical process and in my opinion are conspecific with specimens from as far south as Big Pine Key, Florida.

Oliarus sablensis Caldwell bears a superficial resemblance to several other species, one of which is *O. ecologus* Caldwell. *O. sablensis* and others of the *chuliotus* species group can be separated from *ecologus* by examining the male terminalia *in situ* or, in case of doubt, very obvious differences can be observed after dissection of the male genitalia (see discussion of *O. ecologus*). Another species whose external appearance is occasionally confused with *sablensis* is *O. humilis* (Say). *O. humilis* usually has the apical third of the tegmen much darker than *sablensis*, but darker specimens of *sablensis* are sometimes confused with lighter specimens of *humilis*. The male genitalia of *sablensis* and *humilis* are greatly different but, in lieu of dissections, separation is routinely possible by examining head characters. *O. humilis* usually has a broader, more diverging vertex, broader lateral fovae, and darker carinae of the vertex and face.

Oliarus sablensis Caldwell was described from the holotype male only. It was collected at Cape Sable, Monroe County, Florida, February 14, 1950, (J. S. Caldwell). I have examined and illustrated the type located in the United States National Museum.

Numerous specimens of Oliarus sablensis Caldwell were examined from CANADA: Nova Scotia, Kings County; Ontario, London and Mer Bleue; UNITED STATES: District of Columbia and states of Connecticut, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and West Virginia. Thus, the range of O. sablensis Caldwell extends from Nova Scotia on the northeast through most of the eastern seaboard states to the southern tip area of Florida, north and northwest from Tennessee to Ontario and Minnesota.

Habitat data on the labels of Oliarus sablensis males determined by me include: meadow, herbaceous vegetation, taken in open field, savannah grasses, Carpinus, Populus alba Linnaeus, Quercus alba Linnaeus, Alnus rugosa (Du Roi) Sprengel on weeds, and "Fish Hatch. Brook." The data given by Hendrickson (1930) for O. humilis (Say) actually belong to sablensis. I have seen four of the five specimens referred to as humilis, and I find that the two males are sablensis and that two females appear to be sablensis. The following statement by Hendrickson under O. humilis applies to O. sablensis: "At Andropogon furcatus [=Andropogon gerardi Vitman] consocies, 2.5 mi. south of Ames, July 10-31, 1925, four specimens. At Spartina consocies, 2/5 mi. south of Ames, June 26, 1928, one specimen."

The distribution of Oliarus sablensis Caldwell within its range is spotty or localized and only partly explained by the fortuitous activities of collectors. At Gainesville, Forida, I have found it only at one locality, so far, and not in the numerous other sweepings of mine and other collectors from the Gainesville area. This one location consists of a low, open mixture of herbs and grasses. No specimens were taken in the adjacent uphill turkey oak-scrub habitat or in the downhill palmetto thicket or stream side swamp forest. Some clumps of grasses were unearthed in the open area, but I found no nymphs. A more systematic and extensive examination of the roots of the various plants is needed to find what the precise host plants are. The area was highly disturbed before I first collected in it. It has been cut-over, burned-over, and drained by an artificial ditch. The area probably should be classified as a type of pine-flatwoods.

The seasonal distribution of *Oliarus sablensis* Caldwell at a particular latitude is such that I believe this species is single-brooded. The range of dates probably can be partially explained by edaphic and meteorological differences, and by the tendency of some individuals of a brood to hatch or develop at a different rate from the majority. On a continental basis, the records appear in keeping with the bioclimatic law. In south Florida the earliest record is the holotype (February 14). At Gainesville, in north central Florida, I have collected adults from early April to the last of May, with peak numbers coming in late April and early May. In the northern part of its range records extend from late May to late July in the United States, with June being the peak month. The Mer Bleue, Ontario, Canada, specimens were collected August 9, 1932.

OLIARUS CHULIOTUS BALL

Figures 114, 115, 255, 256, 355, 417, 418, 458, 503, 553, 577

Oliarus chuliotus Ball, 1934. J. Wash. Acad. Sci. 24:271-272 (Key 270).

Oliarus gladensis Caldwell, 1951. Ohio J. Sci. 51:35. New synonymy.

Length of male 3.8 to 4.9 mm (based on 36 specimens). Ground color of vertex and mesonotum medium brown to brownish black; mesonotal carinae from concolorous to contrasting orange. Head: Vertex varying from moderately narrow to moderately broad, the length in middle line varying from distinctly less than, to equal to width at apex of posterior emargination; median carina variable, usually short and feeble. Face various shades of brown; carinae prominent, orange; maculae absent; frons wider than long in middle line. Rostrum short, failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae usually joining pale band of posterior margin but in some specimens tangential to or slightly separated from posterior margin. Mesonotum with carinae fairly prominent, intermediate pair slightly weaker than other carinae. Tegmina usually nearly immaculate, most specimens with only slight brownish suffusion at apical crossveins, other specimens with membranes of basal half of tegmen moderately fumose with brown or with entire tegmen slightly dusky in addition to fuscous at apical crossveins; tubercles concolorous, not prominent; veins generally brownish throughout; apical cells normally 10, anteapical cells 5; stigma a distinct roundish, short, brownish area usually less than twice as long as broad. Legs brown basally, pale yellow distally, unbanded.

Male terminalia: Aedeagal complex as in figures 114 and 115; usually with seven pointed processes, rarely with only six, occasionally with adventitious subprocesses or forks which would increase the total to eight or more if counted. Periandrium usually with six processes, two of which are dorsal; dextral processes well developed, usually fairly straight, unforked, long, and accuminate, extending caudad of aedeagal joint, apex straight or curving slightly left; some specimens with dextral process having a short lateral fork or subprocess originating approximately two-thirds the distance from the base of the process; sinistral process well developed but shorter than dextral process, its basal half swollen but directed straight caudad, apical part thinner and usually ending in a short hook to the left, the recurvature usually approximately 180 degrees; median apical area giving rise to a moderate-sized process directed caudad then curving left-cephalad, usually fairly straight apically but in a few specimens curving throughout length and almost completing a loop; inner left apical area giving rise to a prominent process directed primarily to the left; dorsal periandrium with sclerotized mass giving rise to two pointed processes both variable in shape and length, but the left one nearly always longer than the right one, the latter extending right-laterocephalad sufficiently far to be seen when complex is arranged for ventral view, but some specimens (from Illinois, Mississippi, and Ohio, for example) with this right dorsal process longer and directed primarily caudad "over" the flagellum; left process of dorsal periandrium curved variously from nearly straight left to nearly straight caudad. Flagellum directed left and with no apical process, but with a slender basiventral process which is usually slimmer in basal half or at least than the middle portion; this process directed nearly straight left to a variable extent. Styles as in figures 255 and 256; symmetrical; apex of shaft recurved approximately 125 degrees, apex of recurved portion bluntly rounded; inner processes fairly short, somewhat fingerlike. Connective as in figure 577; moderately proportioned; combined width of ventral arms slightly broader than base of shaft in posterior aspect. Pygofer as in figures 355, 417, and 418; medioventral process in ventral aspect somewhat ovate, constricted at base, apex broadly pointed, extending posteriorly a little more than half the distance to level of apices of pygofer lateral lobes; pygofer lateral lobes very nearly symmetrical, moderately produced, apices subtruncate, usually slightly convex in lateral view. Anal segment as in figures 458, 503, and 553; short, nearly as wide as long; symmetrical; medioapical margin in dorsal aspect usually slightly concave (occasional specimens have straight or slightly convex margins); medioventral profile in caudal aspect usually slightly concave.

Specimens of _Oliarus chuliotus_ Ball require examination of the aedeagal complex for diagnosis. It is close to _O. bispinus_ Caldwell and very close to _O. sablensis_ Caldwell, and these three species form a distinct group. They may be separated by the absence of a flagellar process in _bispinus,_ a basiventral process on the flagellum in chuliotus, and two processes on the flagellum, one ventral, the other apical, in sablensis. A few specimens of sablensis have the apical process of the flagellum reduced and almost intermediate with chuliotus.

Specimens of Oliarus chuliotus Ball were located in various museums misidentified as O. complectus Ball, O. franciscanus (Ståhl), and Platycixius calvus Van Duzee. I have placed O. gladensis Caldwell in synonymy after examining its holotype. The Mississippi records that Dozier (1928) included under O. humilis (Say) are O. chuliotus Ball.

Ball (1934) published the type series as follows: "Holotype female April 17, 1927, allotype male Apr. 18, 1927, paratype females Apr. 17, 1927, and Apr. 15, 1928, all taken by the writer [E. D. Ball] at Sanford, Fla. A female, Homestead, Fla., May 15, 1928. A male, Eustice, Fla. Apr. 6, 1926, taken by the writer [Ball] and a male, Haw Creek, Fla., Oct. 8, 1887." "Eustice" is misspelled in the publication but is correct on the pin label as "Eustis". Ball's type material which is in the United States National Museum, was not found in the type collection there but in the line collection and without the usual type labels. I have placed notes on the appropriate specimens, giving my opinion that these are indeed the types. The evidence for believing these specimens compose the type series is that they match the species description and label data as given by Ball; Ball's individual style of labeling is recognized; no other specimens matching the type data have been found and the only female having the exact data of the holotype female as given in the description has a small plain piece of red paper on the pin, partially hidden by the locality label. I interpret this red paper as Ball's mark for the holotype. There is a male on the same point with the holotype female and I interpret this male to be the allotype since I found no other males with the Sanford, Florida, label among the potential specimens. It seems evident that Ball somehow reversed the dates on a male and female from Sanford when he prepared his manuscript. The female paratype listed for Sanford, April 17, actually is labeled April 18; the male allotype, listed for April 18, must be the male with the holotype dated April 17. The locality Haw Creek, not easily found on a map, lies almost entirely in Flagler County. It flows into the southeast part of Crescent Lake.

Specimens examined include males from ARKANSAS: Howard County; DISTRICT OF COLUMBIA; FLORIDA: Dade, Flagler, Lake, Okaloosa, and Seminole Counties; GEORGIA: Thomasville in Thomas County; ILLINOIS: Charleston in Coles County, DuBois and Elizabethtown in Hardin County; KANSAS: Douglas County; MISSISSIPPI: Okalona in Chickasaw County, Tupelo in Lee County; NORTH CAROLINA: Lake Junaluska in Haywood County; OHIO: Delaware and Hocking Counties; SOUTH CAROLINA: Clemson College in Pickens County.

The known range of Oliarus chuliotus Ball includes localities in nine states plus the District of Columbia. The states are all in the southeastern United States except Ohio, Illinois, and Kansas. The northernmost record is Delaware County in central Ohio, the southernmost, Dade County, Florida.

Habitat information on Oliarus chuliotus Ball is limited, but there is some evidence from the locality labels that chuliotus inhabits mesic situations. At Destin, Florida, it was taken at night by R. E. Woodruff, May 16, 1960, when he was beating turkey oak, Quercus laevis [Walter]. Mr. O. L. Cartwright of the Smithsonian Institution collected a good series of Oliarus chuliotus by sweeping cane, Arundinaria sp., in bottomland of the Seneca River, Clemson South Carolina.

The earliest seasonal record for Oliarus chuliotus Ball is February at Paradise Key, Florida. Other Florida records include April, May, and October 8, 1887. Farther north, most of the records are in May, June, and July, and there is one August record.

OLIARUS BISPINUS CALDWELL

Figures 110, 111, 251, 252, 353, 414, 456, 501, 551, 575

Oliarus bispinus Caldwell, 1947. Pan-Pac. Ent. 23:150-151.

Length of male 3.7 to 4.0 mm (based on five specimens). Ground color of vertex and mesonotum fuscous to piceous; mesonotal carinae usually concolorous, occasionally weak orange, with median carina usually having the most color. Head: Vertex elongate, width variable, but longer in middle line than broad at apex of posterior emargination; median carina present, usually extending anteriorly one-third the basal length of the disc, but in some specimens extending nearly one-half length of disc. Face fuscous to piceous; median carina narrowly orange, color usually more conspicuous on frons; median carina distinctly elevated and with triangle formed by basal fork well calloused; pale color of lateral carinae conspicuous on frons, not or scarcely extending distally to postclypeus; frons rather narrow, width but little greater than length in middle line. Rostrum short, not attaining caudal margins of posterior trochanters.

Thorax: Pronotum with intermediate carinae narrowly separated from pale band of posterior margin or tangential thereto. Mesonotum with all carinae conspicuous, especially the median one. Tegmina immaculate except for slight brownish suffusion at apical crossveins; commissure darkest immediately basad of union of Y-veins, the dark area gradually fading basally; tubercles moderately prominent, concolorous with brownish veins; apical cells normally 10 and anteapical cells 5; stigma rich brown, distinct, ovoid, length approximately twice the width. Legs dark brown basally, grading to yellowish distally; not banded.

Male terminalia: Aedeagal complex as in figures 110 and 111; total pointed processes six. Periandrium with six processes, two of which are dorsal in origin, in ventral aspect the dextral process unusually long, extending posteriorly over and past the aedeagal joint, stout basally but tapering into a slender, acuminate, slightly sinuous process distally; sinistral process shorter, less tapered than the dextral process, stout basally, with left profile twice repand, apex curving left, uncinate, medioapical area with a prominent falciform process to the left; inner apical area with a fairly straight process emerging and directed to the left; dorsal periandrium with two processes coming off a common sclerotized area, with the sclerotized area originating in the median basal position, then diverging into two opposed, unequal processes, the left process much the smaller and directed to the left, the right process much thicker, longer and directed to the right, then curving lateroventrad and slightly cephalad. Flagellum directed to the left, without pointed processes, but the cephalodorsal apex with a semirounded sclerotized plate, the caudoventral apex with conspicuous membranous tissue. Styles as in figures 251 and 252; apex recurved more than 90 degrees but less than 135 degrees; apex of recurved portion bluntly rounded; the recurved portion about same width and twice as long as width of shaft of style when viewed in broadest aspect; shaft of style moderately stout, long and straight; inner processes moderately short and slender, and with apices broadly pointed.

Connective as in figure 575; moderately short and stout; combined width of ventral arms slightly greater than width of base of shaft in posterior aspect. Pygofer as in figures 353 and 414; symmetrical; medioventral process in ventral view symmetrical, somewhat ovate, broadly pointed; process extending posteriorly approximately two-thirds distance to the level of the apices of the pygofer lateral lobes, lateral lobes in lateral view moderately produced, extending farthest caudad distinctly below midlength of posterior margins, apices slightly variable, subacute. Anal segment as in figures 456, 501, and 551; short, almost as wide as long in dorsal aspect, very nearly symmetrical; medioapical margin in dorsal view nearly straight or slightly concave; in caudal view ventral profile slightly concave.

Oliarus bispinus Caldwell is a rare species of southwestern Texas. It superficially resembles a small specimen of *O. corvinus* Ball. *O. bispinus* is closest to *O. chuliotus* Ball and *O. sablensis* Caldwell, the three forming a distinct group. *O. bispinus* is the only one of these three species lacking a ventral, left-directed process originating in the basal area of the flagellum.

The type material is limited to the holotype male from Chisos Mountains [Brewster County], Texas, July 17, 1946 (D. J. and J. N. Knull), in the Ohio State University collection. Male specimens examined in addition to the type include three from the Davis Mountains, Jeff Davis County, Texas (D. J. and J. N. Knull), July 2, 1940, July 23, 1946, and July 28, 1946, Ohio State University collection; one from Uvalde County, Texas, May 11, 1946 (D. J. and

J. N. Knull), Ohio State University collection; and two from Big Bend, Brewster County, Texas, June 24, 1947 (R. H. Beamer), University of Kansas collection.

The known range of Oliarus bispinus Caldwell is southwestern Texas, primarily in the Chisos Mountains of the Big Bend area and the Davis Mountains which lie approximately 100 to 125 miles northwest of the Chisos Mountains. The only other locality is Uvalde County, Texas, which lies approximately 200 miles due east of the Chisos Mountains.

Oliarus bispinus Caldwell is closely related to O. chuliotus Ball and O. sablensis Caldwell both of which occur in the eastern half of the United States and apparently are a part of the Carolinean fauna. I have seen no Mexican or other southwestern forms close to bispinus. Perhaps O. bispinus is derived from the Carolinean fauna and has become fairly well isolated in mountain and plateau systems of southwestern Texas.

No specific habitat or host information is available concerning Oliarus bispinus, but the known seasonal distribution extends from May 11 to late July or early August.

OLIARUS ACICUS CALDWELL

Figures 13, 14, 123, 124, 263, 264, 359, 462, 507, 557, 581

Oliarus acicus Caldwell, 1947. Ohio J. Sci. 47:76.

Length of male 4.1 to 5.1 mm; (based on 31 specimens) holotype 4.7 mm. Ground color of vertex and mesonotum piceous; mesonotal carinae concolorous. Head: Vertex barely longer in middle line than broad at apex of posterior emargination; median carina absent or very short. Face usually piceous; median carina percurrent but orange color confined mostly to frons. Basal fork usually slightly longer than wide; lateral carinae usually a broader and paler orange or yellow; frons distinctly wider than long in middle line. Rostrum short, distinctly failing to attain caudal margins of posterior trochanters.

Thorax: Pronotum with intermediate carinae joining posterior margin. Mesonotum with carinae approximately equally prominent. Tegmina immaculate, without spots or suffusion around apical cross-veins; tubercles not prominent; veins mostly brownish; usually with 11 apical and 5 anteapical cells; stigma brown, well defined, ovoid, approximately twice as long as wide. Legs primarily piceous or fuscous basally, testaceous distally.

Male terminalia: Aedeagal complex as in figures 123 and 124; pointed processes somewhat variable and subject to interpretation but with three conspicuous processes and usually with one or two small ones. Periandrium with three or four processes, without the usual elongate dextral and sinistral processes of most species of Oliarus; no dorsal processes; ventrally, the longest process originating in the apical area and directed left-ventrocephalad; other processes all variable in size but three in number and developing from a well sclerotized basal ring, the median of these largest and deltoid in ventral aspect and sometimes with a confluent subprocess; left process of basal ring short, acuminate, tending to be larger than right process which varies from a stout, toothlike process to a small protuberance or even obsolescence. Flagellum directed to the left, subapically curving 90 degrees caudad; flagellum with one process, a very unusual helical or convolute process inserted basiventrally and extending left, curving dorsad and caudad, and looping back to nearly straight-ventrad or right-ventrad. Styles as in figures 263 and 264; essentially symmetrical in all features; somewhat angulately recurved distally, apex of recurved portion bluntly pointed; inner process moderately produced, pointed; midlength of inner margin of shaft with large protuberance. Connective as in figure 581; moderately long and slender; combined width of ventral arms slightly greater than width of base of shaft in posterior aspect. Pygofer as in figures 13, 14, and 359; medioventral process moderate in size; in ventral profile subterete basally, acuminate at apex, greatest width one-half to two-thirds length; extending posteriorly one-half to two-thirds distance to level of apex of left lateral lobe; lateral lobes moderately produced, symmetrical, appearing pointed and directed nearly straight caudad in ventral aspect; apices subacute to truncate in lateral view, most strongly produced somewhat below midlength of posterior margin. Anal segment as in figures 467, 507, and 557; in dorsal view nearly symmetrical; distinctly longer than wide; medio-apical margin slightly concave; in caudal view ventral profile with a conspicuous spiniform process.

Oliarus acicus Caldwell agrees with the salient features of the subgenus *Melanoliarus* (Fennah 1945) and is hereby assigned to it. Characters of this subgenus were discussed above. The other United States species in this distinctive subgenus are *O. complectus* Ball and *O. viequensis* Caldwell. They differ from *acicus* by not having the tortuous, recurved, basiventrally inserted flagellar process, nor having the apical half or third of the flagellum curving caudad at right angles. Both *complectus* and *viequensis* have processes originating on the apical area of the flagellum which *acicus* does not. From the standpoint of male genitalia, *acicus* is one of the most easily recognized species in the Nearctic region. It is very distinct even from other members of the same subgenus. In its southwestern range it usually can be separated from other species of *Oliarus* by its black body and unmarked tegmina. Some morphological variation occurs but it is infraspecific and of a low magnitude in the material examined. *O. acicus* has been common in insect collections from southwestern United States and misdetermined as *complectus* Ball.

The holotype male, allotype female, 11 male and 4 female paratypes are in the United States National Museum. A paratype female is in the California Academy of Sciences collection. Specimens in the type series exhibit the usual venational variations in the tegmina but typically have Sc with two branches at the margin, R with two, M with five, and Cu_1 with two. My interpretation of the aedeagal complex differs from that in the original description. Caldwell did not recognize the presence of any periandrial processes but did list the aedeagus with two (his use of the term "aedeagus" is equivalent to my use of "flagellum"). One of the two processes mentioned by Caldwell is probably what I consider the apicoventral process of the periandrium. The other periandrial processes are of the short type, developing from the ventral and lateral surfaces of the basal ring or plate.

The range of Oliarus acicus Caldwell is the southwestern border area of the United States and parts of northern Mexico. Specimens were examined from UNITED STATES: Texas (mostly Rio Grande Valley locations): Bexar, Brewster, Cameron, Hidalgo, Nueces, Uvalde, Val Verde, and Webb Counties; Arizona: Cochise County (Portal 4800'), Pima County (San Xavier Mission, Baboquivari Mountains, Arivaca), Yuma County (Yuma); California: San Diego County, Imperial County (several locations in the Colorado River delta and in the Imperial Valley); MEXICO: Lower California: San Miguel; Sonora: Hermosillo and Yaqui Valley; Sinaloa: 11 miles south of Guasave, El Dorado, and Los Mochis. O. acicus appears to be allopatric within the subgenus Melanoliarus. An undescribed form similar to O. viequensis Caldwell has been taken as close as Monterrey, Nuevo Leon; elsewhere this undescribed form has been collected in the states of Michoacan, Veracruz, Morelos, and Oaxaca in material at my disposal. On the western side of Mexico, I have seen a specimen of an apparently new species in subgenus Melanoliarus from San Blas Beach, Nayarit, which is the first state south of Sinaloa. The label data show that

O. acicus has been collected primarily in river valleys and irrigated areas of the southwestern United States and northern Mexico.

Oliarus acicus Caldwell seems to be positively phototropic, since several specimens from several states have such labels as "at light," "ex Argon light trap," "blacklight trap." Other habitat labels read: "ex peach" [Prunus persica (L.) Stokes] and "on Sphaeralcea angustifolia" [(Cavanilles) George Don], from Texas; "ex Gossypium sp. by D-Vac machine," "ex Gossypium hirsutum" [Linnaeus], and "ex Melilotus indica" [Allioni], from Imperial Co., California; "sweeping alfalfa [Medicago sativa Linnaeus] in Los Mochis, Sinaloa.

Oliarus acicus Caldwell apparently is a multivoltine species. The available specimens were collected in every month except April. The Sinaloa records are for January, May, and December; the Sonora records are for March and November; Lower California for July; Arizona for April and July; Texas for February, March, and May through December; California for March, and June through October.

OLIARUS COMPLECTUS BALL

Figures 10, 11, 119, 120, 259, 260, 357, 460, 505, 555, 579

Oliarus complectus Ball, 1902. Can. Ent. 34:152.

Oliarus cinereus; Wolcott, 1921. J. Dep. Agric. P. Rico 5:18-19; fig. 4.

Oliarus complectus; Ball, 1934. J. Wash. Acad. Sci. 24:273-274 (Redefined).

Oliarus franciscanus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:56, 61-63 (Forty references, with all records of complectus combined under franciscanus (Stål).

Oliarus franciscanus; Wolcott, 1936. J. Agric. Univ. P. Rico 20: 95-96; illus. (Bionomics, distribution).

Oliarus franciscanus; Osborn, 1935. Scient. Surv. P. Rico 14:118, 197-198; fig. 46 (Systematic notes). Equals Oliarus complectus Ball, in part.

Oliarus complectus; Wolcott, 1941. J. Agric. Univ. P. Rico 25:53 (Plant associations, distribution).

Oliarus complectus; Beatty, 1947. J. Agric. Univ. P. Rico 28:124 (Listed).

Oliarus franciscanus; Martorell, 1947. J. Agric. Univ. P. Rico 29: 266. (Listed).

Oliarus campestris Fennah, 1945. Proc. biol. Soc. Wash. 58:141-146; pls. 11-12, figs. 1-3, 44, 62 (Described, notes).

Oliarus franciscanus; Ramos, 1947. J. Agric., Univ. P. Rico 30:17 (Plant associations, distribution).

Oliarus complectus; Caldwell, 1947. Ohio J. Sci. 47:76 (Comparative note).

Oliarus franciscanus; Wolcott, 1950. J. Agric. Univ. P. Rico 32:132-133 (Bionomics, distribution).

Oliarus campestris Fennah, 1949. Psyche 56:51-53 (Zoogeography, internal anatomy).

Oliarus complectus; Caldwell, 1950. Am. Mus. Nov. 1460:1 (Distribution).

Oliarus complectus; Caldwell, 1952. J. Agric. Univ. P. Rico 34:138-141; pl. 2 (Systematic notes).

Length of male 3.4 to 4.2 mm, allolectotype male 3.95 mm. Ground color of vertex and mesonotum dark brown to black; mesonotal carinae usually concolorous. Head: Vertex in middle line a little longer than broad at apex of posterior emargination; median carina absent. Face fuscous except carinae yellowish to dull orange, color sometimes confined to carinae of frons but usually variably extending into clypeal region; fork of median carina forming small equilateral triangle; frons wider than long in middle line. Rostrum short, distinctly failing to attain caudal margins of posterior trochanters.

Thorax: Pronotum with intermediate carinae tangential to pale band of posterior margin. Mesonotum with carinae nearly uniform. Tegmina immaculate; veins brownish, commissure pale to ochraceous except for fuscous portion immediately basad of union of Y-veins; tubercles moderate in size, concolorous and therefore not conspicuous; 11 apical and 5 anteapical cells; stigma brown, ovoid, well defined, with length approximately twice width. Legs fuscous basally, usually ochraceous to testaceous distally.

Male terminalia: Aedeagal complex as in figures 119 and 120; total pointed processes seven or eight depending on variation and interpretation of same. Periandrium with five or six processes, without any lengthy dextral or sinistral processes developing basally; a medium small, slender, dorsoapical, retrorse process originating adjacent to dorsal base of flagellum; with two medium-sized, ventro-apical processes, the larger one directed right-ventrad initially but also immediately curving left-ventrad and slightly cephalad; smaller ventroapical process originating more dorsad and to the left, and directed primarily to the left in ventral aspect, smoothly curving left-ventrad from cephalic viewpoint; ventral, basal ring with two short, broad, pointed processes right- and left-laterad, median process often obsolete or represented by a callosity. Flagellum with two slender and acuminate processes in the apical area, the longer one originating dorsally, following contour of flagellum, looping dorsad, then basad, nearly attaining level of basal ring; the other shorter process originating basidorsally, and directed primarily right-caudad; these flagellar processes somewhat variable in directions extended. Styles as in figures 259 and 260; nearly symmetrical in all features; apex enlarged and recurved, becoming somewhat narrowed and pointed at end of recurved portion; inner processes fairly short, pointed; midlength of shaft with large protuberance. Connective as in figure 579; moderately long and slender; combined ventral arms wider than base of shaft in posterior aspect. Pygofer as in figures 10, 11, and 357; medioventral process moderate in size; length nearly twice the width; process extending posteriorly a little more than half the distance to level of lateral lobes; lateral lobes of pygofer moderately produced, rounded to subtruncate at apices which lie somewhat ventrad of midlength of posterior margin. Anal segment as in figures 460, 505, and 555; distinctly longer than wide in dorsal view (width about three-fourths the length) and nearly symmetrical, distinctly concave at apical medioventral margin; convex in caudal view, with apex becoming a sharp downward-pointed spine; in lateral view apical process deflexed and attenuated.

Oliarus complectus Ball is the most commonly collected *Oliarus* in the Greater Antilles but is rare in the United States, being known only from a few specimens in Florida. In the United States *complectus* is closest to *O. acicus* Caldwell and *O. viequensis* Caldwell, which are the other United States members in the subgenus *Melanoliarus*. The Caribbean fauna may not be sufficiently understood to permit full diagnosis of *complectus* in this subregion, but other forms in subgenus *Melanoliarus* Fennah are present. *O. complectus* is similar enough to *O. viequensis* and *O. acicus* that examination of the aedeagal complex is usually necessary. *O. complectus* is easily separated from these two species by the presence of an apical retrorse process on the dorsal periandrium. The other two species not only lack this process but have no processes anywhere on the dorsal periandrium. Furthermore, *complectus* has two fairly similar ventroapical processes of the periandrium that primarily extend to the left. The other two species routinely have only one apical process which is directed ventrad primarily. *O. complectus* and *O.*

vieguensis each have two apical processes on the flagellum compared to none for acicus, although the last does have one long corkscrew-like process originating basally. In complectus the members of this apical pair of flagellar processes are fairly similar in length and thickness, with the shorter member usually directed right-ventrocephalad. However, in vieguensis neither one of the processes is directed right-ventrocaudad, and the anteriorly directed member of the pair is approximately twice as large in thickness and length. The deflexed median apical spine of the anal segment in complectus is distinctly shorter than that in acicus, but only slightly shorter than that of vieguensis.

Probably the most noticeable variation routinely encountered concerns the different directions taken by the apical processes of the flagellum. Another common variation is the basal ring of the periandrium which is either binate or ternate or grading between. The most atypical complectus examined is a specimen from Crescent City, Florida, formerly in the P. R. Uhler collection but now in the United States National Museum. Crescent City lies adjacent to freshwater Crescent Lake in Putnam County, 25 miles inland from the Atlantic Ocean. In this specimen the only process of the basal ring is located on the right side. The ventroapical periandrium has only one process, instead of the usual two; furthermore, this one process is directed primarily to the right instead of to the left as is usual. The apical pair of processes on the flagellum shows differences, with one member exceedingly long and directed left initially, then curving back to the right and dorsad, as seen in ventral view, to disappear and end behind the median dorsal area of the periandrium. The retrorse apical process of the dorsal periandrium in this specimen is present as usual.

The type series of Oliarus complectus Ball is mixed. Ball (1934) stated that his original series contained at least two and probably three species. I have seen 18 marked individuals of the type series of 24 or 25 specimens and discovered four species in this group. Ball (1934) wrote that, "in order to definitely limit it [complectus] to the species intended in the original description, the holotype is fixed on a female from Port Au Prince, Haiti, and the allotype on a male from the same place, both examples so labeled and in the author's collection." This really is a lectotype designation, although it is somewhat deficient in detailed information usually given in such designations. Additional information on the lectotype follows. The top label reads "Pt. au Pr." on the first line, "Hayti feb" on the second, with all machine printed on white paper except that "feb" is hand printed with India ink. The next label has "TYPE" machine printed on white paper. The third label is red paper and is machine printed "Cotype No." on the first line, "U.S.N.M." at the bottom, with blank space between top and bottom lines. The fourth label is red and has "HOLOTYPE" machine printed across the top, "O. complectus" hand printed with India ink in the middle area, and "E. D. Ball" machine printed at the bottom. I have added a black-bordered lectotype label with "LECTOTYPE" machine printed in red across the top, "Oliarus complectus Ball" hand printed with India ink in the middle area, and

"E. D. Ball" in India ink on the bottom after the machine printed "By" in red ink. This lectotype is located in the United States National Museum, along with most of the type series. In addition to Ball's "holotype" and "allotype" from Port Au Prince, Haiti, two males and four females with "cotype" labels also are from this locality. Some of the original type series with the same label data may be unmarked as to type status. For example, a male in the Iowa State University collection perfectly matches the locality label of the lectotype and allolectotype. The only type material seen outside the United States National Museum consists of a male and a female on the same pin, having yellow paratype labels, and located in the California Academy of Sciences collection. This pair is labeled: "Effingham, Ks. July 1900, EPVan Duzee, Collector." I dissected the male and found it to be O. ecologus Caldwell. A "cotype" male collected at Las Animas, Colorado, July 17, 1901, was dissected and determined as O. dondonius Ball. Three "cotype" males from Phoenix, Arizona, May 1897, were found to be O. zyxus Caldwell. Ball (1934) assumed all the forms with a median apical spine on the anal segment were complectus; hence, he considered specimens from southern Arizona, adjacent Mexico, and "many places in Florida" to be conspecific with the Haiti specimens of complectus.

Since Ball disdained the dissection of male genitalia, he did not realize his 1934 concept of Oliarus complectus still included other species (the species currently known as O. acicus Caldwell and O. viequensis Caldwell).

I now presume the taxon Oliarus complectus Ball is stabilized unless it can be shown that Oliarus lunata (Fabricius) is complectus.

The type of O. lunata (a West Indian species) is a female, and female characters are not sufficiently understood at this time to permit accurate determinations in very closely related species. Even if lunata and complectus are the same, complectus should be conserved on the basis of its frequent appearance in economic literature contrasted with the antiquity (described in 1803) and lack of economic information on lunata (Fabricius). Another Caribbean species from Trinidad, in subgenus Melanoliarus, is Oliarus maidis Fennah, the type-species of this subgenus. From the description of maidis it seems very close to complectus. I have seen the holotype of maidis, but the male genitalia are missing. A former worker at the United States National Museum has told me that the genitalia of maidis holotype were accidentally destroyed. Therefore, the two paratype males of maidis listed for the British Museum of Natural History take on increased importance for future workers.

Ever since its original description, Oliarus complectus Ball has been a source of confusion for reasons enumerated above. Another reason has been the vagueness surrounding O. franciscanus (Stål), which has priority over complectus if the two are considered synonymous. The original description of franciscanus was not sufficiently detailed to separate it from a number of American forms including the complectus mixed series. No resort was made to the type of franciscanus, apparently, because it was located in the far off Natural History Museum at Stockholm, Sweden. For nearly half a century franciscanus and complectus were greatly intermixed in usage. Metcalf (1936) in his catalogue lumped all complectus references under franciscanus, following the lead of Van Duzee (1917a) who listed complectus as a synonym of franciscanus. It remained for Caldwell (1952) to borrow the type of franciscanus and show that "all forms previously determined as franciscanus are not that species." In the same paper Caldwell also synonymized O. (Melanoliarus) campestris Fennah under complectus, and he summarized the available biological data on complectus. Thus interpreted, all previous determinations for O. complectus Ball in mainland North America are erroneous. The only North American mainland records of complectus known to me are from Florida, which are here presented for the first time. Oliarus franciscanus (Stål) on the other hand is a South American species about which I will publish separately.

The range of Oliarus complectus Ball is primarily in the Greater Antilles but it has been taken sparingly in Florida and in the northern Lesser Antilles. Already mentioned is the atypical specimen from Crescent City, Putnam County, in the northeastern quarter of Florida. Other Florida records include the following specimens from Monroe County: one male, on grasses, Big Pine Key, December 28, 1951 ("Rich. & Stan."); one male, Big Pine Key, 7-V-61 (H. V. Weems, Jr.); two males, Big Pine Key, Stop #3, 7-V-61 (F. W. Mead); and one male, Big Pine Key, VI-18-1965 (Lois and C. W. O'Brien). I have determined other male specimens from Cuba, Haiti, Dominican Republic, and Puerto Rico. Literature records that seem valid include Jamaica, Vieques Island, Caja de Muertos Island, Mona Island, and St. Thomas and St. Croix, Virgin Islands.

Additionally, with campestris Fennah relegated to synonymy under complectus, the distribution listed for it automatically becomes that of O. complectus. The localities listed by Fennah (1945b and 1949) for campestris are: Jost Van Dyke, British Virgin Islands, Antigua, St. Kitts (on beans), Nevis, Montserrat, and Hope, Jamaica.

Caldwell (1950) determined O. maidis Fennah from Guadeloupe. Thus, the southern limit of O. complectus and the northern limit of O. maidis are adjacent islands, but they are separated by an unusually significant part of the sea. Fennah (1946) wrote that, "a distinct break in faunal continuity ... occurs between the island of Guadeloupe and the Leeward Islands which lie to the north of it. Here the stretch of intervening sea is abnormally large, being about fifty miles." Later, Fennah (1949) wrote, "Oliarus campestris (= complectus) is very clearly replaced in the Windward Islands and Trinidad by O. maidis Fenn."

"Host" labels on specimens I have determined as Oliarus complectus Ball include Cordia, at canefield, on sugarcane leaves, on Cedrela odorata Linnaeus and on citrus. The last was in Cuba, the others in Puerto Rico.

Agricultural situations and crops from which Oliarus complectus has been taken include pastures, cotton, soybeans, eggplants, papayas, pigeon peas, carrots, beans, tomatoes, potatoes, asparagus, corn, avocado, yams (Dioscorea sp.) and sugarcane. Sein (1932, 1933) found that the nymphs of O. complectus (reported as O. franciscanus) are subterranean and feed on the roots of sugarcane and "malojillo." The latter is better known as paragrass, Panicum *purpurascens* Raddi (=*P. barbinode* Trin.). Sein noted that the nymphs were somewhat gregarious, whitish, and covered with waxy white fluff, the surplus of which lined the cavity in soil where they fed on a sugarcane rootlet. Apparently, neither nymphs or adults caused any feeding or other injury to the sugarcane plants. Attempts by Sein to implicate *complectus* as a vector of sugarcane mosaic were unsuccessful. Fife (1939) found *complectus* in limited numbers on cotton in Puerto Rico where it was the only fulgoroid collected on cotton in his studies. Wolcott (1950) stated that Dr. Alexander Wetmore found them (*complectus*) eaten by the tody, *Todus mexicanus*, and they are so preferred by lizards as to constitute 5 percent of the food of the grass lizard, *Anolis pulchellus*. *O. complectus* Ball apparently is a multivoltine species, since numerous records are available for all months of the year.

OLIARUS VIEQUENSIS CALDWELL

Figures 12, 121, 122, 261, 262, 358, 461, 506, 556, 580

Oliarus viequensis Caldwell, 1952. J. Agric. Univ. P. Rico 34:141; pl. 2.

Length of male 3.2 to 4.1 mm (based on 125 specimens); ground color of vertex and mesonotum fuscous to piceous; mesonotal carinae usually concolorous but in some specimens partially a contrasting dull orange. Head: Vertex distinctly longer in middle line than broad at apex of posterior emargination; median carina absent. Face fuscous to piceous; median carina percurrent, usually ochraceous to dull orange on frons and duller on clypeus, basal fork narrow but distinct; lateral carinae varying from ochraceous to dull orange to light brown; frons moderately narrow, with length in middle line usually two-thirds the width. Rostrum short, distinctly failing to attain caudal margins of posterior trochanters.

Thorax: Pronotum with intermediate carinae joining pale band of posterior margin. Mesonotum with carinae conspicuous, the middle one usually a little more so; tegmina immaculate, except for faint suffusion at apical crossveins; tubercles not conspicuous; veins usually light brown basally, becoming darker brown apically except claval vein and basal and apical portions of commissure which are stramineous, 11 apical and 5 anteapical cells; stigma brown, well defined, with length usually twice that of width. Legs with femora fuscous except narrowly pale yellow at apex, and with tibiae and tarsi mostly pale yellow or ochraceous.

Male terminalia: Aedeagal complex as in figures 121 and 122; total pointed processes six. Periandrium with four processes, without any lengthy dextral and sinistral processes; no dorsal processes; with three well-spaced short processes on sides and ventromedian area of a basal ring; ventroapical area with a moderate-sized, slightly curving process directed ventrad primarily. Flagellum with two processes originating from common tissue in ventroapical area; the shorter process directed caudad initially, curving dorsad apically; the longer process approximately twice as thick and long as the shorter process and directed cephalad primarily but also slightly curving dorsad. Styles as in figures 261, 262; nearly symmetrical in all features; each shaft with large protuberance and with apex unevenly recurved, the apex of recurved portion bluntly pointed; inner processes rather short, pointed. Connective as in figure 580; moderately long and slender; combined ventral arms slightly wider than base of shaft in posterior aspect. Pygofer as in figures 12, 358; medioventral process in ventral aspect moderate in size, sides subparallel basally, acute, width approximately two-thirds the length, and extending posteriorly at least half the distance to level of lateral lobes but more often about three-fifths this distance; lateral lobes of pygofer symmetrical, weakly produced below midlength of posterior margin in lateral view. Anal segment as in figures 461, 505, and 556; distinctly longer than wide in dorsal view and fairly symmetrical but with left caudal margin slightly longer than its right counterpart; medioapical margin distinctly concave; in caudal view ventral profile with moderately long, acuminate spine or process extended ventrad; spine in lateral view rather stout and directed nearly 45 degrees ventrocephalad.

Oliarus viequensis Caldwell agrees with the major features of the subgenus Melanoliarus Fennah and is hereby assigned to it. The other United States species in this distinctive subgenus are O. acicus Caldwell and O. complectus Ball. O. viequensis and complectus have two apical processes on the flagellum which acicus lacks, but acicus does have a basally arising, helical flagellar process not present on the other two species. O. viequensis can be separated from complectus as follows: viequensis has only one ventroapical process on the periandrium, whereas complectus has two; viequensis has no dorsal processes, but complectus has a retrorse apical process on the dorsal periandrium.

Morphological variation is minor for the most part. Occasional specimens have the small, median, basiventral, toothlike process obsolete. The most atypical specimens are five males from Cedar Key, Levy County, Florida, "Ju. 12, 1939" (P. W. Oman). These specimens have the basiventral process of the periandrium larger than normal and more to the left; the apicoventral process of the periandrium instead of emanating from a smoothly rounded area, arises from a protuberance; the apical processes of the flagellum are shaped somewhat differently and directed more to the left, particularly the more caudal member of the pair which loops dorsad over the flagellum, then curves left-cephalad in such a way as to become parallel with the larger process of the pair.

No attempt has been made in this thesis to treat fully the Mexican material, but enough specimens from Mexico have been examined to know that a form close to *viequensis* is present in at least four states from Oaxaca on the south, to Monterrey, Nuevo Leon, on the north. The differences, though slight, seem to be consistent and possibly represent a new taxon.

The holotype male from Vieques Island, Puerto Rico, allotype female, and eight paratypes from Cape Sable, Monroe County, Florida were examined by me in the United States National Museum. The holotype lacked a collector label at the time of my visit in June 1963. The original description is accurate except that the direction given for the periandrial process "to the right" should read "to the left"; the directions given for aedeagus of "right apical process" should read "anteroapicoventral process", and for "left process" should read "posteroapicoventral process."

The range of *Oliarus viequensis* Caldwell is primarily Antillean, but includes Florida. The original description lists Vieques Island, Puerto Rico; St. John, Antigua; Cape Sable, Florida. I have seen typical material from Puerto Rico, St. Marc, Haiti, and from coastal situations in the following Florida counties: Collier, Dade, Lee, Monroe, Pinellas, Sarasota, and Volusia, plus the atypical form from Levy County. Specimens are available from most of the Florida Keys from Key Largo to Key West. Thus, in Florida, the only Atlantic Coast records north of the Florida Keys are from Daytona Beach and New Smyrna Beach of Volusia County. This may be the result of fortuitous collecting, but it may mean that the Gulf Coast areas are better supplied with the special tidal flat habitats of _viequensis._ At the present time, none of the Cuban specimens examined by me in subgenus _Melanoliarus_ have been _viequensis_; they are all _complectus._ This negative evidence will increase in importance when much more material from Cuba has been examined. _O. viequensis_ and _O. complectus_ are partially sympatric, but even though the ranges overlap, there may be habitat differences. I have taken both species on Big Pine Key, Florida, but where _viequensis_ was abundant I did not collect _complectus._ The place where I took two specimens of _complectus_ I did not obtain any _viequensis._ There is some evidence that _viequensis_ is restricted to saltmarsh situations, but that _complectus_ has a ecological amplitude and is common in agricultural areas, as well as present occasionally in or near saltmarsh habitats and perhaps in or near wooded areas. In summary, _viequensis_ greatly predominates over _complectus_ in Florida, but the reverse is true in the Antilles.

The only habitats in Florida where _Oliarus viequensis_ Caldwell adults seem to be abundant are in open, low-lying, grassy situations of tidal flats, or on woody plants adjacent to the tidal flats. These woody plants probably are temporary resting places or possibly food plants but not host plants. The nymphs almost certainly are subterranean and most probably have adaptations to withstand short periods of flooding as mentioned in some detail by Hacker (1925) on the life history of _Oliarus felis_ Kirkaldy (he believed that the waxy secretion which covers the bodies of the nymphs renders them waterproof). There are many similarities between the habitat of _O. felis_ (Kirkaldy), as described by Hacker, and the Florida habitats where I have taken O. viequensis. One such habitat was at Mullet Key, located at the extreme southwestern tip of Pinellas County, Florida, where Tampa Bay joins the Gulf of Mexico. This habitat was the only place I collected O. viequensis during an afternoon of collecting in several adjacent keys as well as Mullet Key. The aspect of the Mullet Key habitat was much the same as the tidal flat areas in the Florida Keys where viequensis is abundant. These areas have in common a heavy thatch of saltgrasses on muddy tidal flats. In the Lower Keys, primarily Big Pine Key, the tidal flats are sometimes dominated by a creeping, wiry, perennial grass named Monanthochloe littoralis Engelm. Another common perennial grass of muddy tidal flats is the taller Sporobolus virginicus (L.) Kunth. O. viequensis was collected by sweep net in the grass mixture and also in what appeared to be pure stands of these two kinds of saltgrasses. Circumstantial evidence points to these grasses as host plants of O. viequensis. The work of Hacker supports this hypothesis. He collected Oliarus felis (Kirkaldy) among the roots of "saltwater couch grass, Sporobolus virginicus var. minor Bail." This grass formed a dense mat over a low-lying strip of black, sticky, alluvial soil near a tidal creek and a fringe of mangrove trees in Queensland, Australia. Hacker discovered that submergence of the habitat by brackish water for an hour or two apparently did not wet or harm nymphs located around the rootlets of the grass. His collecting at different periods of the year showed felis adults of both sexes were plentiful in November and April, but that only nymphs were present at other times. This suggests that O. felis is a bivoltine species.

Seasonal data indicated that _O. viequensis_ is at least bivoltine. In Florida, adults are numerous in collections from March through July and were abundant on Mullet Key and the Lower Florida Keys during October collecting trips. Records for the other months are fairly scarce. The paucity of wintertime records may reflect a period when adult _viequensis_ waxhoppers are scarce or absent but it could reflect inactivity on the part of collectors, also. Unnatural factors which are having an effect on the insect populations in the Florida Keys are the heavy destruction of habitats by bulldozers for housing projects, alterations by deep drainage ditches for mosquito control, and the application of insecticides to combat biting flies.

Additional collecting data on _Oliarus viequensis_ Caldwell are quoted here from labels on the specimens. "_Borrichia arborescens_" [(L.) DC.] in the Everglades National Park; "blacklight trap"; "collected at light"; "(ex) mangrove"; "on _Avicinnia nitida_" [Jacq.] at Plantation Key, Florida. Several specimens from Puerto Rico have the host label of sea purslane, _Sesuvium_ sp., on them.

In Florida, adults have been collected from March through July, and again in October.

OLIARUS EXOPTATUS VAN DUZEE

Figures 15, 16, 125, 126, 265, 266, 360, 463, 508, 565, 582

Oliarus exoptatus Van Duzee, 1917. Proc. Calif. Acad. Sci. 7:308-309.

Oliarus exoptatus; Ball, 1934. J. Wash. Acad. Sci. 24:270, 272 (Key, comparative notes).

Oliarus exoptatus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:60 (Original citation only).

Oliarus exoptatus; Beirne, 1950. Can. Ent. 82:96 (Comparative note).

Length of male 3.5 to 5.6 mm (based on 20 specimens); holotype nearly 5.6 mm. Ground color of vertex and mesonotum usually fuscous or piceous; mesonotal carinae usually concolorous, occasionally some or all carinae edged with a contrasting light brown or dull orange. Head: Vertex very broad, length in middle line conspicuously less than width at apex of posterior emargination; median carina usually absent or feebly developed but occasionally extending forward one-half to two-thirds length of disc. Face with ground color usually fuscous; median carina usually orange and percurrent but in some specimens partially obsolete on clypeus; basal fork conspicuous; each lateral carina distinct but narrow and yellowish or dull orange throughout its length; maculae absent; frons broad, length in middle line approximately two-thirds width of frons. Rostrum moderately long, extent varying from not quite attaining to slightly exceeding caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae well separated from pale band of posterior margin. Mesonotum with carinae conspicuously and uniformly elevated. Tegmina with degree of spotting variable, a few specimens nearly immaculate, typical specimens with three distinct spots on clavus, a brownish area immediately basad of node, spots on clavus and corium, and conspicuous smoky brown areas in distal third; commissure pale yellow or light brown, without contrasting brown section basad of Y-vein juncture; tubercles conspicuous; veins usually pale yellow on basal three-fourths and fuscous on distal one-fourth of each tegmen; apical cells usually 11 and anteapical cells 6; stigma variable, usually small and brownish, length usually one and one-half to two times the width, but width sometimes equal to length. Legs with all tibiae usually having an indistinct narrow fuscous ring near base; basal segments of legs fuscous, distal segments varying from pale yellow to light purplish brown; posterior leg with first tarsite having seven or eight apical spurs including the lateral pair; second tarsite consistently with eight apical spurs including lateral pair, but each of the six spurs between lateral pair having a small scalelike tooth distally attached.

Male terminalia: Aedeagal complex as in figures 125 and 126; total pointed processes seven. Periandrium with four processes; right basal area giving rise to two long slender processes, the more ventral member of this pair, in ventral aspect, almost straight and directed caudad primarily, but in lateral view uniformly curving caudodorsally, shorter than its dorsal complement; dorsal member of the pair of dextral processes slightly sinuate, extending primarily caudad in lateral or ventral view; sinistral process, in ventral aspect, broad basally and constricted near midlength, thence bladelike and extending nearly straight left to a level near outer margin of flagellum in typical specimens; in other specimens with length of process somewhat reduced but with apex acute, not bifid in ventral or caudal view; dorsal periandrium with a moderate-sized acuminate right apical process directed caudad or right-caudad. Flagellum directed left-cephalad; with three processes: two slender approximate acuminate processes along median posterior margin, both directed to the left; basiventral area of flagellum giving rise to a long slender sinuate process usually directed successively left-cephalad, left and left-dorsad. Styles as in figures 265 and 266; greatly asymmetrical; left style stout, distally unequally bilobed to the left, inner process in the form of an extremely long, strongly curved, acuminate spine; right style broad, distally unequally bilobed, the proximal lobe thumblike, forming an acute angle with main shaft of style, distal lobe shorter, rounded, and directed caudolaterally, inner process in the form of a stout, nearly flattened, obtusely pointed plate, somewhat molarlike in dorsal profile. Connective as in figure 582; combined length of ventral arms slightly variable, usually equal to width of base in posterior aspect. Pygofer as in figures 15, 16, and 360; slightly asymmetrical; medioventral process in ventral aspect slightly constricted at base, irregularly obtuse at apex, subterete between base and apex, and with a transverse keel on ventral surface slightly behind midlength; process extending posteriorly slightly farther than apices of pygofer lateral lobes; lateral lobes short, in lateral view nearly symmetrical, with posterior margin slightly produced and apex occurring well below midlength. Anal segment as in figures 463, 508, and 565; in dorsal view slightly asymmetrical, apex of left margin more laterally expanded than right margin; longer than wide, width approximately three-fourths the length; apical margin broadly and irregularly deeply concave; in caudal aspect ventromedian profile produced into a truncate process.

Oliarus exoptatus Van Duzee was the first described of three very closely related species that form the highly distinctive *exoptatus* group, of which characteristics have been enumerated in the introductory part of this paper. Separation of *O. exoptatus*, *O. beirnei*, new name, and *O. fidus* Van Duzee is difficult, and is based almost entirely upon the shape of the sinistral process of the periandrium and apex of the left style. *O. fidus* can be identified by the spinelike apex of the left style contrasted to the gently convex apex in *beirnei* and *exoptatus*; in ventral view the periandrial sinistral process of *fidus* usually appears semitruncate and directed left-caudad, but in *exoptatus* it develops into a conspicuously longer, acuminate structure directed straight left or nearly so; in *beirnei* the sinistral process is somewhat bifid at the apex and the distal portion is usually directed somewhat ventrad instead of left of left-caudad as in *exoptatus* and *fidus*, respectively.

In some areas of California, forms believed to be *Oliarus exoptatus* Van Duzee have a shorter sinistral process and are close to forms believed to be *beirnei*. *O. beirnei* and *O. exoptatus* are sympatric in the northern half of California. More collecting and further study are needed to confirm the present treatment of the *exoptatus* complex.

Van Duzee described *Oliarus exoptatus* from the holotype male taken by W. M. Giffard at Fallen Leaf Lake [Eldorado County], California, August 21, 1916, on manzanita [*Arctostaphylos* sp.], elevation 6300 feet above sea level, and from the allotype female "taken in Placer Co., August 20, 1916 - - - in collection of Mr. Giffard." I have not located the allotype, but the holotype is in the California Academy of Sciences (No. 375), and has been used for my illustrations.

Other material determined by me as *Oliarus exoptatus* Van Duzee is as follows: CALIFORNIA: Butte County, Paradise; Eldorado County?; "G. Alpine Cr. Tahoe"; Lassen County, Madeline; Marin County, Lagunitas and Mt. Tamalpais; Mariposa County?, Yosemite National Park; Nevada County, Truckee; Placer County, Auburn and Colfax; Plumas County, four miles west of Quincy; Sierra County, Sardine Lakes; Sonoma County, Guernaville; Toulume County, Soulsbyville; Tulare County, California Hot Springs; IDAHO: Latah County, Moscow; NEVADA: Ormsby County, Carson City; UTAH: Cache County, Logan Canyon; ? County, "Blacksmith Fk." Female specimens, probably *exoptatus*, have been collected in COLORADO: Routt County: Steamboat Springs [map elevation 6683 feet above sea level]; and WYOMING: Teton County: 12 miles south of Jackson [elevation 6100 feet above sea level].

Hence, the known range of *Oliarus exoptatus* Van Duzee is primarily in the northern half of California, with the Lake Tehoe area the apparent center of abundance; elsewhere, the species is known from scattered localities of the northern Rocky Mountain system of the United States. Although the data are limited, the preliminary evidence is that exoptatus is not characteristic of the Basin and Range Province. Nearly all of the collecting records are in or near mountainous areas where the habitats presumably are of a more mesic character than found in much of the West.

The available host data include: "ex manzanita" Arctostaphylos sp., "visiting flowers of sage," and "ex Malus sp." The earliest known collecting date is May 15, the latest August 1, with most of the records in June and July.

OLIARUS FIDUS VAN DUZEE

Figures 18, 129, 130, 269, 270, 362, 510, 558, 567, 584

Oliarus fidus Van Duzee, 1914. Trans. S Diego Soc. nat. Hist. 2:37.

Oliarus fidus; Ball, 1934. J. Wash. Acad. Sci. 24:270 (Key).

Oliarus fidus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2: 60 (Four references 1914 to 1917).

Length of male 3.8 to 4.7 mm (based on 10 specimens). Ground color of vertex and mesonotum usually fuscous, sometimes piceous or fuscocastaneous; mesonotal carinae usually concolorous, but median carina orange or yellow in some specimens. Head: Vertex very broad, length in middle line distinctly less than width at apex of posterior emargination; median carina usually absent or feebly developed. Face with ground color fuscous; median carina yellow to brownish yellow and traversing length of face, more conspicuous on frons than on more distal clypeal area; basal fork conspicuous; lateral carinae yellowish and conspicuous; maculae absent or poorly developed; frons broad, ovoid, length in middle line approximately six-tenths the width. Rostrum moderately long, usually reaching or slightly exceeding caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae well separated from pale band of posterior margin. Mesonotum with carinae conspicuously and uniformly elevated. Tegmina with degree of spotting variable, most specimens lightly spotted, a few nearly immaculate; most specimens with costal cell having two or three light brown spots, a few specimens without spots, nearly all specimens with brownish area immediately basad of node; distal portion of each tegmen with suffusion at crossveins, and apical cells occasionally having light brownish areas; most specimens milky subhyaline, others with partial to complete light smoky brown cast; commissure of typical specimens a nearly uniform pale yellow or yellowish brown; tubercles conspicuous; veins usually pale yellow except fuscous near apex; apical cells normally 11 and anteapical cells 6, but variation occurring commonly in number of branches reaching apex of tegmen; stigma unusually small, usually brownish, but sometimes mostly pale; width sometimes equal to length but length usually one and one-half to two times the width. Legs fuscous basally, becoming pale yellow or brownish yellow distally; each front and middle tibia with narrow fuscous band near base; posterior leg having seven or eight apical spurs, including the lateral pair; second tarsite consistently with eight apical spurs including lateral pair, the six spurs between lateral pair having small scalelike teeth distally attached, one per spur.

Male terminalia: Aedeagal complex as in figures 129 and 130; total pointed processes seven. Periandrium with four processes; right basal area giving rise to two long slender processes, the more ventral member of this pair, in ventral aspect, fairly straight and directed caudad primarily, but in lateral view uniformly curving caudodorsally, shorter than the dorsal member of the pair; the dorsal of the two dextral processes slightly sinuate, primarily extending caudad in lateral or ventral view; sinistral process, in ventral aspect appearing bluntly produced left-caudad from a broad base, but in most views with apex pointed (not bifid) and primarily extended ventrad; dorsal periandrium with a moderate-sized acuminate right apical process usually directed right-caudad. Flagellum directed left-cephalad; with three processes: two slender approximate acuminate processes along median posterior margin, both directed to the left; basiventral area of flagellum giving rise to a long slender sinuate process successively directed left-cephalad, left, and left-dorsocaudad. Styles as in figures 269 and 270; greatly asymmetrical; left style stout, distally unequally bifid, one ramus extending laterally as a lobe, the other ramus acuminate, spinelike, slightly curved and extended left-caudad; inner process in the form of an extremely long, strongly curved, acuminate spine; right style stout, distally bilobed, the proximal lobe thumblike, forming an acute angle with main shaft of style; the distal lobe shorter, semi-rounded, and directed caudolaterally; inner process in the form of a stout, nearly flattened, obtusely pointed plate, somewhat molar-like in dorsal profile. Connective as in figure 584, short and slender; combined width of ventral arms approximately equal to width of base in posterior aspect. Pygofer as in figures 18 and 362; slightly asymmetrical; medioventral process in ventral aspect slightly constricted at base, apex obtuse, subterete between base and apex, and with a transverse keel on ventral surface near midlength; process extending posteriorly slightly farther than apices of pygofer lateral lobes; lateral lobes short, in lateral view nearly symmetrical, with posterior margin slightly produced and apex occurring well below midlength. Anal segment as in figures 510, 558, and 567; in dorsal view slightly asymmetrical, left margin more laterally expanded than the right margin; longer than wide, with width approximately two-thirds the length; apical margin broadly and irregularly deeply concave; in caudal aspect ventromedian profile produced into a truncate process.

Oliarus fidus Van Duzee is a member of the O. exoptatus Van Duzee complex and very close to exoptatus as well as to O. beirnei, new name, the other species in this complex. I separate O. fidus from exoptatus and beirnei by the spinelike caudal extension of the left style of fidus as contrasted to the rounded, lobelike development in the other two species (see discussion under O. exoptatus for more comments on diagnosis).

Van Duzee described Oliarus fidus from "numerous examples taken on the rocky hillside south of the railway station at Foster [San Diego County, California] on May 24th 1913." No holotype was designated but Van Duzee later selected a specimen for lectotype and placed yellow paratype labels on nearly all the remainder of the syntypes. Van Duzee died before this lectotype designation was submitted for publication. I have examined Van Duzee's "lectotype" and used it for most of the illustrations in this paper. I hereby designate this specimen as lectotype of Oliarus fidus Van Duzee and added the label, "F. W. Mead Specimen No. III-13641" and a new lectotype label to the one already affixed by Van Duzee. The lectotype is labeled "San Diego Co. Cal., 5-24-13, E. P. Van Duzee," all machine printed (on white paper) except the date which is hand printed. The exact number of specimens in the original type series is not known but I have seen 16 specimens that are marked as "paratype" or "cotype." The lectotype and all but two of the paralectotypes are in the California Academy of Sciences collection at San Francisco. These other two are located in the United States National Museum.

OLIARUS BEIRNEI, NEW NAME

Figures 17, 127, 128, 267, 268, 361, 464, 509, 566, 583

Oliarus artesmisiae Beirne, 1950. Can. Ent. 82:93-96; illustrated, not *Oliarus artemisiae* Matsumura, 1914. New synonymy.

Length of male 4.2 to 5.5 mm (based on 17 specimens). Ground color of vertex and mesonotum usually fuscous, sometimes piceous or fuscocastaneous; mesonotal carinae usually concolorous, sometimes a lighter orange-brown. Head: Vertex very broad, length in middle line distinctly less than width at apex of posterior emargination (1:1.2 - 1.47); median carina absent or weakly developed. Face with ground color fuscous; median carina yellowish, well elevated at basal fork and distally along frons and part of postclypeus, but usually becoming confluent or nearly so in apical part of postclypeus; lateral carinae yellowish and conspicuous; maculae absent or poorly developed; frons broad, ovoid, length in middle line approximately seven-tenths the width. Rostrum moderately long, apex approximately even with caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae well separated from pale band of posterior margin. Mesonotum with carinae conspicuously and uniformly elevated. Tegmina with degree of spotting greatly variable, some specimens nearly immaculate except for suffusion around apical crossveins, other specimens heavily spotted in several areas; most specimens with four spots in costal cell, including one immediately basad of node; spots in discal cells, areas around forks of Cu_1 and Y-vein forming a nearly continuous diagonal line in better marked specimens; distal third of tegmen with brownish areas at crossveins and apical margin; tubercles large, conspicuous in contrast to veins which mostly are pale yellow or brownish yellow except fuscous near apex; commissure pale yellow throughout its length in some specimens, an indistinct yellow-brown basad of Y-vein juncture in other specimens; apical cells normally 11 and anteapical cells 6; stigma brownish and small, less than twice as long as wide. Legs fuscous basally, becoming pale yellow or brownish yellow distally; each front and middle tibia with narrow fuscous band near base; first tarsite of each posterior leg having seven or eight apical spurs, including the lateral pair; second tarsite consistently with eight apical spurs, including lateral pair, but the six spurs between lateral pair having very small scale-like teeth distally attached, one tooth per spur.

Male terminalia: Aedeagal complex as in figures 127 and 128; total pointed processes seven, but somewhat subject to interpretation and variation. Periandrium with four conspicuous processes and occasionally with a very short toothlike subprocess near middle portion of ventral surface; right basal area giving rise to two long slender processes, the more ventral of these, in ventral view, directed caudad and straight to slightly sinuate, but in lateral view curving uniformly caudodorsally; shorter than the dorsal member of the pair; the more dorsal of the two dextral processes slightly sinuate, primarily extending caudad in lateral view or ventral view; sinistral process a broad, poorly developed, somewhat bifid process directed straight left, somewhat variable in shape; dorsal periandrium with a moderate-sized right apical process directed dextrocaudad primarily. Flagellum directed left-cephalad; with three processes: two approximate slender acuminate processes along median posterior margin, both directed to the left; and a long slender sinuate process arising on left basiventral area of flagellum, directed left-cephalad most of basal portion, distally curving to left or left-caudad. Styles as in figures 267 and 268; greatly asymmetrical; both stout, distally curving outward at approximately 90 degree angle into an asymmetrical bilobed structure; inner process of left style in the form of an extremely long, outwardly curved, acuminate spine; inner process of right style in the form of a stout, nearly flattened, obtusely pointed plate, somewhat molarlike in dorsal profile. Connective as in figure 583; rather short and slender; combined width of ventral arms slightly less than width of base in posterior aspect. Pygofer as in figures 17 and 361; nearly symmetrical; medioventral process in ventral aspect long, subterete, apex obtuse, subapically with a transverse keel, process extending posteriorly as far as or slightly farther than apices of pygofer lateral lobes; pygofer lateral lobes short, in lateral view posterior margin slightly produced, caudalmost part occurring well below midlength. Anal segment as figures 464, 509, and 566; in dorsal view slightly asymmetrical, longer than wide, with width approximately two-thirds the length; apical margin broadly, irregularly, and deeply concave; in caudal aspect median profile produced into a stout process; ventral profile concave between median process and tectiform lateral margins.

Oliarus beirnei, new name, is very close to O. exoptatus Van Duzee and O. fidus Van Duzee, these three species forming the exoptatus complex. Diagnosis of these species is dealt with in the discussion of exoptatus.

The type series of Oliarus beirnei consists of the holotype male and a paratype male having the same collection data of Seton Lake, Lillooet, British Columbia, Canada, on sagebrush [Artemisia sp.], June 30, 1926 (J. McDunnough). Both the holotype and paratype have the number 5876 in the Canadian National Collection, Ottawa. The head and male genitalia of the holotype were illustrated by Beirne; I have examined the paratype and used it to illustrate this paper.

Other male specimens, examined and believed to be conspecific with Oliarus beirnei, are from: CANADA: British Columbia: Goldstream, Vancouver Island; UNITED STATES: California: Del Norte County, Siskiyou National Forest; Fresno County, Huntington Lake; Mendocino County, Twin Rocks; Placer County, Auburn and Colfax; Shasta County; Tehama County, 15 miles west of Mineral; Trinity County, Weaverville; Oregon: Jackson County, Medford; Washington: Pierce County, Puyallup. Thus the apparent range of beirnei includes scattered localities from the southwestern corner of Canada, south through western Washington and Oregon to the northern half of California in the United States.

The only host information available for Oliarus beirnei, new name, is that the type series was collected "from sagebrush" [Artemisia sp.]. The collecting dates on 14 specimens of beirnei extend from June 9 to July 14.

OLIARUS QUINQUELINEATUS (SAY)

Figures 74, 217, 218, 296, 334, 391, 439, 484, 534

Flata quinquelineata Say, 1830. J. Acad. nat. Sci., Philad. 6:241.

Oliarus quinquelineatus; Provancher, 1889. Petite Faune ent. Canada: 223 (Described, equals Flata quinquelineata (Say).

Oliarus quinque-maculatus (sic); Van Duzee, 1914. Trans. S Diego Soc. nat. Hist. 2:36-37 (Comparative note).

Oliarus quinquelineatus; Ball, 1934. J. Wash. Acad. Sci. 24:270 (Key).

Oliarus quinquelineatus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:99-100 (Catalog of 36 references 1830-1930).

Oliarus quinquelineatus; Brimley, 1938. Insects North Carolina: 100 (Listed).

Oliarus quinquelineatus; Osborn, 1938. Ohio biol. Surv. Bull. 6:299-301 (Key, descriptive notes, distribution, illustrations).

Oliarus quinquelineata; Beirne, 1950. Can. Ent. 82:94-95 (Key, descriptive notes, distribution).

Length of male 5.4 to 6.7 mm (based on 50 specimens). Ground color of vertex and mesonotum fuscous to castaneous; carinae of mesonotum usually concolorous, occasionally a specimen having one or more of the carinae dull orange. Head: Vertex moderately broad, variable, length in middle line usually about equal to width at apex of posterior emargination; median carina variable, extending anteriorly various distances up to midlength of disc; foveae moderately broad, length approximately twice the width. Face usually fuscous to brunneus, occasionally castaneous; carinae prominent, color variable from brown to orange, median carina usually dull orange in full extent, lateral carinae usually orange only on frons; maculae usually present but reduced to a slightly curved line, nearly obsolete in some specimens; frons moderately narrow, width distinctly greater than length in middle line. Rostrum moderately long, usually slightly surpassing posterior trochanters.

Thorax: Pronotum with intermediate carinae separated from pale band of posterior margin. Mesonotum with all carinae prominent. Tegmina highly variable, some specimens almost immaculate, other specimens variously banded and spotted with fuscous; well marked specimens with two or three spots in costal cell; tubercles unusually conspicuous because of heavy pigmentation contrasting with pale veins, the veins generally pale except where brownish spotting or banding occurs; apical cells normally 12, anteapical cells 6 in number; stigma a distinct brown patch, broad, length usually one and one-half to two times the width. Legs with front and middle tibiae indistinctly banded, the brown hands two in number for each tibia.

Male terminalia: Aedeagal complex as in figure 74; major pointed processes four, plus many spinelike processes and lightly sclerotized, lobelike process or pseudoprocesses. Periandrium with four processes of the usual sort plus many short, spiny subprocesses; general structure of periandrium highly modified and subject to different interpretations; ventrally with a gross multispined, heavily sclerotized process originating in apical area of the periandrium, giving rise anteriorly to a moderately slender, fairly straight, pointed process directed ventrocephalad primarily, and posteriorly giving rise to a moderately slender process that curves anteapically; with numerous short, slender processes between the two rami of the gross process on extremes of this ventral periandrial mass, some of these entire, others in clusters with several points coming off one stem; basal, left lateral area of periandrium giving rise to a recurved, moderately slender process directed straight right-caudad in the apical portion; dorsal process originating in the right basal area, gradually curving left-caudad, gently sinuate, slender entire length with apex about opposite apex of flagellum.

Flagellum directed less than 45 degrees left-caudad, with large flat keellike sclerotized structure, and with a subapical, lightly sclerotized lobe directed a short distance to the left. Styles as in figures 217 and 218; symmetrical or nearly so; apex of style curved approximately 90 degrees dorsolaterally; each shaft fairly straight; inner processes long, fingerlike, extending beyond apex of recurved portion, each process with a tubercle along the caudal margin. Connective as in figure 296; long and moderately stout; combined width of ventral arms greater than base of shaft. Pygofer as in figures 334 and 391; medioventral process long, reaching or nearly reaching level of apices of pygofer lateral lobes; in ventral aspect narrowest at base, somewhat sagittate but rounded at apex; pygofer lateral lobes symmetrical or nearly so, stout in ventral aspect, moderately produced in lateral aspect, apices bluntly rounded or subtruncate. Anal segment as in figures 439, 484, and 534; flaplike, long and moderately narrow in dorsal aspect, medioapical margin truncate; ventral profile in caudal aspect nearly straight, with slight concavity at midlength.

_O_. _quinquelineatus_ (Say) is one of the most common and widely distributed species of _Oliarus_ in North America. The only species very close to it in general appearance and in male terminalia is _O_. _vicarius_ (Walker). _O_. _vicarius_ usually is longer and the tegmina are more highly colored. There are several small but consistent differences in the male terminalia, even where the species overlap in range in the southeastern United States. This is excellent evidence that the two forms are distinct species. The medioventral pygofer process of _vicarius_ is distinctly shorter and more pointed than in _quinquelineatus_; the inner style process of _vicarius_ does not have the small protuberance that is present in _quinquelineatus_, and the recurved apex of the style in _vicarius_ is slightly broader than in _quinquelineatus_; the left lateral process of the periandrium of _vicarius_ is recurved at the apex, instead of straight apically as in _quinquelineatus_; the caudal portion of the large, ventral process of the aedeagus complex of _vicarius_ is straight, but is curved as much as 90 degrees in _quinquelineatus_; the long dorsal periandrial process of _vicarius_ tends to be a little broader than its counterpart in _quinquelineatus_.

Oliarus vicarius (Walker) and _O_. _quinquelineatus_ (Say) both have the very unusual large multispined ventral process of the aedeagal complex. No other species I have seen even approaches such a multiplicity of tiny processes. There is a tendency for _vicarius_ to have more of these tiny processes than does _quinquelineatus_.

The type of _Oliarus quinquelineatus_ (Say) is presumed lost with the other Say material.

The type locality given by Say was "New Jersey." I have selected a specimen from Roselle, New Jersey, to illustrate the male terminalia. This specimen was collected "6-23-1924" by E. D. Ball, and is in the United States National Museum collection. I have placed an F. W. Mead Specimen No. VII-19651 label on the pin.

Numerous specimens were examined from which I give the range as follows: Nova Scotia, Ontario, and Quebec Provinces in Canada; Maine, Massachusetts, Connecticut, and New York in the northeastern United States, south through Pennsylvania, New Jersey, Maryland, Virginia, North Carolina, South Carolina, Georgia, north Florida, west through Mississippi, Oklahoma (Arbuckle Mountains), and Colorado (Boulder, Colorado Springs, Golden), and east to the midland states of Iowa, Minnesota, Wisconsin, Illinois, Indiana, and Ohio. Additionally, I have seen female specimens which most probably are _Oliarus quinquelineatus,_ from Alabama, Arkansas, Louisiana, and Tennessee. There seems little doubt that additional collecting and further examination of insect collections will reveal that _O. quinquelineatus_ is in all the states east of the Mississippi River and perhaps a few more states west of the Mississippi River.

Any records of _Oliarus quinquelineatus_ for the southern half of Florida are open to question. The southernmost locality I have for the species is one male from Gainesville, Alachua County, in north central Florida. The only other Florida records are from Liberty and Okaloosa Counties in the colder "Panhandle" portion of Florida (northwestern Florida). The records by Frost (1963, 1964) of _quinquelineatus_ at Archbold Biological Station in Florida are based upon misidentified specimens of _O. vicarius._

Oliarus quinquelineatus (Say) and the closely related O. vicarius (Walker) appear closest to the O. placitus Van Duzee group. The general appearance of all these species is much the same and they all have the unusual aedeagal complex, featuring the flagellum directed caudad primarily, instead of the usual approximately 90 degrees or more to the left.

Say (1830) in the original description stated that quinquelineatus occurred on Pinus rigida [Miller] early in August (in New Jersey). Labels on specimens I have examined include: "collected from under bark of wilting Q. ellipsoidalis" [Quercus ellipsoidalis E. J. Hill]; "sweeping hickory" [Carya]; "Quercus laevis [Walter] association"; "beating turkey oak at night" [Quercus laevis]; light trap; black-light trap and "about 5600 ft. alt." [Boulder, Colorado]: "on Pinus virginiana" [Miller] [State of Maryland]; "Solidago roots" and "near Solidago roots" at Vienna, Virginia, May 15, 1938 (nymphs). These nymphs are assumed to be Oliarus quinquelineatus on the basis of similar nymphs from Vienna, Virginia, having been reared the previous year and determined as O. quinquelineatus from the adults.

A nymph collected by J. C. Bridwell at Vienna, Virginia, October 11, 1936, emerged as an adult male on January 18, 1937. Another nymph from the same place, collected January 1, 1937, was reared and emerged as an adult male on January 16, 1937. Apparently nymphs of O. quinquelineatus overwinter, since fairly well developed nymphs emerge as adults in late spring under normal conditions in Virginia.

OLIARUS VICARIUS (WALKER)

Figures 2, 4, 75, 76, 218, 220, 297, 335, 336, 392, 440, 485, 535

Cixius vicarius Walker, 1851. List Homop. British Mus. 2:343.

Oliarus vicarius; Distant, 1907. Ann. Mag. nat. Hist. 19:280 (Listed).

Oliarus vicarius; Van Duzee, 1914. Trans. San Diego Soc. nat. Hist. 2:36-37 (Comparative note).

Oliarus vicarius; Ball, 1934. J. Wash. Acad. Sci. 24:270 (Key).

Oliarus vicarius; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:107 (Catalog, 18 entries 1851-1928).

Oliarus vicarius; Spooner, 1938. Univ. Ill. Bull. 35:52-53, 58-59, 62-63 (Anatomy).

Oliarus vicarius; Brimley, 1938. Insects North Carolina:100 (Listed).

Oliarus vicarius; Osborn, 1938. Ohio biol. Surv. Bull. 6:300 (Comparative note).

Oliarus quinquelineatus; Frost, 1963. Fla Ent. 46:30 (Misdetermination; collecting note).

Oliarus quinquelineatus; Frost, 1964. Fla Ent. 47:133 (Misdetermination; collecting note, Florida).

Oliarus vicarius; Frost, 1964. Fla Ent. 47:133 (Collecting note, Florida).

Length of male 6.0 to 8.2 mm (based on 107 specimens). General appearance of head and thorax approximately same as *Oliarus quinquelineatus* (Say), except stigma of tegmen tending to be more narrow. Tegmen and wing as in figures 2 and 4.

Male terminalia: Aedeagal complex as in figures 75 and 76. Styles as in figures 219 and 220. Connective as in 297. Pygofer as in figures 335, 336, and 392. Anal segments as in 440, 485, and 535.

Terminalia, in general, very close to those of Oliarus quinquelineatus (Say) except as noted in discussion under the latter.

Oliarus vicarius (Walker) is very close to O. quinquelineatus (Say), and the two species have been in a state of a confusion for a long time. The more obvious differences are noted in the discussion of quinquelineatus. Male specimens of vicarius almost always can be separated from quinquelineatus without recourse to dissections simply by comparing the medioventral processes of the pygofers; that of vicarius is much shorter and more acuminate.

The type of Oliarus vicarius (Walker) was collected at St. Johns Bluff [Duval County] Florida, and presented to the British Museum by E. Doubleday. Professor David A. Young, Jr., of North Carolina State University examined this type and made pencil drawings of the dorsum of the head and thorax, and also drawings of most of the male terminalia which are in a balsam mount. Professor Young's drawings of the type have formed the basis of my determinations of male specimens of vicarius, and also confirm the correctness of Van Duzee's identifications and comparisons made in 1908.

The known range of Oliarus vicarius (Walker), from numerous males I have determined, is as follows: coastal plain and border areas between coastal plain and piedmont (except one record from Atlanta, Georgia) from North Carolina on the north, south through South Carolina, Georgia, and Florida. In Florida, it is common throughout all regions of the peninsula, but in west Florida (the "Panhandle") it is localized. In this region I have seen it only from Torreya State Park, Liberty County, and Pensacola, Escambia County. Georgia localities include Atlanta and Lowndes and Mitchell Counties. South Carolina localities include River Bridge State Park, Bamberg County, and "Bush House," Aiken County. North Carolina localities include Carolina Beach and Southern Pines.

There is a definite tendency for Oliarus vicarius (Walker) to be associated with woody plants. At Olustee, Baker County, Florida, E. P. Merkel collected numerous specimens in blacklight traps suspended in pine trees and it has been taken in blacklight traps several other areas in Florida. It was collected on "pine" in Miami, Florida; in auto at Miami, Florida; on jeep (automobile) at Crystal Beach, Florida; in malt trap at Estero, Florida, and by beating turkey oak, Quercus laevis Walter, at night at Pensacola, Florida (R. E. Woodruff); on Galactia elliottii Nuttall (R. A. Morse) in Alachua County, Florida; on quava, Psidium guajava Linnaeus at Miami; in Steiner trap with tri-med, QME lure, suspended in a calamondin tree at Bartow, Florida.

The known seasonal distribution of Oliarus vicarius (Walker) extends from late February to July 26. This is probably a univoltine species.

OLIARUS PLACITUS VAN DUZEE

Figures 86, 89, 229, 230, 303, 341, 399, 445, 490, 540

Oliarus placitus Van Duzee, 1912. Bull. Buffalo Soc. nat. Sci. 10:493-494.

Oliarus placitus; Van Duzee, 1914. Trans. San Diego Soc. nat. Hist. 2:36 (Comparative notes).

Oliarus placitus: Ball, 1934. J. Wash. Acad. Sci. 24:270 (Key).

Oliarus placitus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. 4, part 2:95-96 (Eight references 1912 to 1928).

Oliarus placitus; Osborn, 1938. Ohio biol. Surv. Bull. 6:300-301 (Comparative notes, distribution, illustration).

Oliarus placitus; Caldwell, 1947. Pan-Pac. Ent. 23:145-146 (Comparative note).

Oliarus placitus; Beirne, 1950. Can. Ent. 82:94 (Key, distribution, illustration).

Length of male 6.1 to 8.8 mm (based on 40 specimens). Ground color of vertex and mesonotum fuscous to fuscocastaneous; carinae of mesonotum concolorous in most specimens, occasionally marked with faint orange. Head: Vertex moderately broad, length in middle line varying from slightly less than to slightly more than width at apex of posterior emargination; median carina weakly to moderately developed. Face usually castaneous; carinae pale yellowish to orange throughout lengths; median carina percurrent and unusually prominent, with large fork at base; maculae varying from a weak, narrow spot to conspicuous roundish spot; frons moderately narrow, width distinctly greater than length in middle line. Rostrum long, distinctly surpassing caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae separated from posterior margin. Mesonotum with all carinae prominent. Tegmina variable in degree of spotting, some specimens nearly immaculate, others moderately to heavily spotted; costal cell usually with three weakly developed spots (sometimes obsolete); tubercles prominent, especially the pigmented ones on pale veins; veins variable in color from stramineous to brownish, most specimens with veins fairly pale; apical cells normally 12 and anteapical cells 6; stigma a distinct brown patch, length varying from two and one-fourth to three times the width. Legs with front and middle tibiae with alternating yellow and brown bands, the latter two in number for each tibia.

Male terminalia: Aedeagal complex as in figures 86 and 89; total pointed processes subject to interpretation because of forking in periandrial processes; minimum five processes, maximum eight. Periandrium unusual, no dextral process present; the sinistral process in more of left-dorsal rather than usual left-ventral position; left, median, basiventral area of periandrium giving rise to a "wishbone" or Y-shaped process, the fork occurring before midlength, each branch fairly slender, the inner one longer; dorsomedian area occupied by a very large, broad process that terminates in two widely diverging, acute branches of an apical fork, the right ramus somewhat shorter than the left; sinistral process bifid at the apex, generally similar to the median dorsal process, but the rami of the apical fork of the left lateral process shorter. Flagellum directed nearly straight caudad but at slight angle to left; with two apical processes, one of which is quite long, very slender, lightly sclerotized and directed at least 90 degrees to the left; the other process very short, slender, well sclerotized, and directed 35-45 degrees to left-caudad. Styles as in figures 229 and 230; moderately asymmetrical in apical portion; basal part of each shaft approximately twice as broad as part of shaft adjacent to apical expansion; _in situ,_ the shafts curving around medioventral process of pygofer; apex of each style with unequal but similar outer, rounded, preapical lobes; apex of right style more pointed than that of the left style; inner processes comparatively long and slender, extending dorsad _in situ;_ inner process of right style clavate in profile, stouter than the slender, acuminate inner process of the left style. Connective as in figure 303; moderately stout, somewhat tilted at base (therefore, slightly asymmetrical); combined width of ventral arms substantially greater than width at base of shaft in posterior aspect. Pygofer as in figures 341 and 399; medioventral process in ventral aspect greatly expanded, narrowest at base, widest near apex, apex usually slightly concave, the process appearing slightly bilobate, extending posteriorly to or nearly to level of the apices of the pygofer lateral lobes; lateral lobes in ventral aspect moderately narrow, diverging; in lateral aspect, lobes symmetrical or nearly so, moderately produced and broadly truncate. Anal segment as in figures 445, 490, and 540; symmetrical or nearly so; distinctly longer than wide in dorsal aspect and with medioapical margin slightly concave; in caudal view hoodlike, median part of ventral profile moderately concave.

Oliarus placitus Van Duzee is the most common and the first of four species forming the *placitus* group. *O. placitus* is closest to *O. montanus* Metcalf, in which the vertex is broader and more diverging basally than in most specimens of *O. placitus*, but neither this nor other external characters that I have studied are reliable for separating these two species. *O. placitus* can be separated from *montanus* and other species by the very distinctive characters of the aedeagal complex. The two long, broad, apically expanded and bifid processes of the periandrium are conspicuous and peculiar to *placitus*. Other species I have seen incorrectly determined as *placitus* in various museums are: *O. aridus* Ball, *O. difficilis* Van Duzee, *O. quinquelineatus* (Say), and *O. vicarius* (Walker). It is difficult to separate the last two species from *O. placitus* without the use of male terminalia, although there is a distinct tendency for the punctures on the veins of the tegmina of *quinquelineatus* and *vicarius* to be more prominent than on *O. placitus*, and *placitus* usually is a darker brown.

I have not observed any significant variation in the aedeagal complex of *Oliarus placitus*, but there is considerable variation in the total length of the individuals and in the degree of brownish areas or spots in the tegmina.

Van Duzee described *Oliarus placitus* from one male and ten female examples taken at Spring Creek, Decatur County, Georgia, June 7-23, 1911 (J. G. Bradley) and from one male taken by himself at Ft. Myers, Lee County, Florida, May 3-5, 1908. Of the original type series, I have examined the Ft. Myers male paratype and used it to illustrate the male terminalia. It is located in the California Academy of Sciences collection and has a yellow paratype label on it. I do not know the location of the other male. Of the 10 females, I have seen two on loan from the California Academy of Sciences collection, and they have yellow paratype labels on the pins. Six of the remaining eight females are located in the Cornell University collection. They all carry a white label with the information, "Cornell U. Lot 409 Sub. 1." Each specimen also carries a large red paratype label with "Oliarus placitus Van D." in script, and there is a blue paratype label with Cornell U. No. 792.1 to 792.6 machine printed except for the number itself, each "paratype" having a different number in the 10ths column. Perhaps it was Van Duzee's intention to make the Spring Creek, Georgia, male or one of the two "missing" females the lectotype, but he did not publish a lectotype designation.

The known range of Oliarus placitus Van Duzee extends from New Jersey on the northeast, south to Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Alabama and Florida, plus the midwestern states of Kansas, Illinois and Ohio. The only Canadian record is a male from Pelee Island in Lake Erie, the southernmost area of Ontario and Canada. Dozier (1928) recorded placitus for Mississippi. I have seen female specimens from Mississippi with Dozier's determination labels, and I believe he is correct, but it is difficult to determine placitus females with certainty. The literature records of _placitus_ in New York state hinge upon a male specimen in the American Museum of Natural History. It was collected at Flatbush, Long Island, New York, 18-VI-1894 (J. L. Zabrieskie). This specimen is not _placitus_ but is _O. quinquelineatus_ (Say).

Oliarus placitus Van Duzee apparently is positively phototropic, as there are numerous records of it collected at light or in a blacklight trap. It also has been collected in a Steiner trap in an orange tree [_Citrus_ sp.], taken in a Malaise trap, taken in woodland and pine flatwoods, on trunks of apple trees [_Malus_ sp.], and on "_Cornus stricta_" at Mount Vernon, Virginia.

The known seasonal distribution of specimens collected in Florida extends from April 17 to July 12; in the more northern part of its range the records are all for June and July. _Oliarus placitus_ Van Duzee probably is a univoltine species.

OLIARUS MONTANUS METCALF

Figures 87, 88, 231, 232, 304, 342, 400, 401, 446, 491, 541

Oliarus montanus Metcalf, 1923. J. Elisha Mitchell Soc. 38:179-180; figs. 269, 566; Key 160.

Oliarus montanus; Dozier, 1928. Tech. Bull. Agric. Exp. Stn Miss. 14:64-65 (Diagnostic characters; original description repeated).

Oliarus montanus; Ball. 1934. J. Wash. Acad. Sci. 24:270 (Key).

Oliarus montanus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:83-84 (Listed).

Length of male 7.0 to 7.6 mm (based on 20 specimens); length of holotype 7.4 mm. Vertex and mesonotum medium to dark brown, carinae of mesonotum brownish to dull orange. Head: Vertex broad, length in middle line distinctly less than width at apex of posterior emargination; median carina usually extending anteriorly approximately half length of disc. Face usually castaneous, varying to fuscous in some specimens; carinae varying from yellow to orange, median carina percurrent and pale from base through most or all of anteclypeus, tending to be less prominent on postclypeus, conspicuously forked at base; maculae weakly developed, crescent-shaped, almost obsolete in some specimens; frons moderately narrow, width greater than length in middle line (1.13 to 1.4:1). Rostrum long, slightly surpassing caudal margin of posterior trochanters in most specimens.

Thorax: Pronotum with intermediate carinae separated from posterior margin. Mesonotum with all carinae conspicuous. Tegmina varying from lightly to moderately spotted, with most of spots in clavus and apical portion of corium, but three or fewer spots present in costal cell of some specimens, these spots obsolete or nearly so in other individuals; tubercles moderately prominent; veins predominately brownish but becoming intermixed white and dark apically; apical cells normally 12 and anteapical cells 6; stigma a distinct brown patch, somewhat ovoid, length two to two and one-half times width. Legs with front and middle tibiae with alternating yellow and brown bands, the brown bands two in number for each tibia.

Male terminalia: Aedeagal complex as in figures 87 and 88; total primary pointed processes five, secondary (adventitious) processes appearing in some specimens. Periandrium with three prominent processes, one or more adventitious subprocesses present in some specimens; in ventral aspect, with a stout process developing left-basally tapered and directed left-caudad, curving approximately 90 degrees left-cephalad near apex, thereby becoming hooklike, inner profile entire or with one to three, spines or small subprocesses; two other prominent processes arising from right and left basidorsal areas; right dorsal process slender and sinuate with apex mostly directed right-ventrad; left-dorsal process moderately slender, curving through nearly entire length, but directed caudad primarily in basal two-thirds, then mostly right-ventrad in apical one-third. Flagellum directed at shallow angle (less than 45 degrees to the left from straight posterior direction; with two very slender, lightly sclerotized processes, the apical one usually longer than the sub-apical process, both processes slightly curved and extending to left or left-cephalad; right-ventrolateral portion of flagellum with rigid, keellike structure. Styles, as in figures 231 and 232; weakly to moderately asymmetrical in apical portion; basal half of shaft approximately twice as broad as part of shaft adjacent to apical expansion; _in situ_, the shafts curving around large medioventral process of pygofer; apex of each style unequally bilobate, the outer lobe short and rounded, the inner lobe long, slender, recurved to form a partial loop, bluntly rounded at apex; without inner processes in usual sense unless recurved inner lobe at apex is considered a modified inner process. Connective as in figure 304; asymmetrical at base of shaft, the left side more caudad, the right side more cephalad (tilted); general aspect short and stout; in posterior view the combined length of ventral arms very long, approximately twice width of base of shaft. Pygofer as in figures 342, 400, and 401; medioventral process in ventral aspect greatly expanded, slightly longer than wide, narrowest at base, widest in distal half, slightly asymmetrical, weakly convex, truncate, or concave at apex, extending posteriorly distinctly beyond level of apices of pygofer lateral lobes; lateral lobes in ventral aspect thin, diverging, in lateral aspect symmetrical or nearly so, strongly produced, subacute with apices rounded. Anal segment as in figures 446, 491, and 541; hood-like, nearly symmetrical, distinctly longer than wide in dorsal aspect, with medioapical profile feebly concave, this portion of the anal segment strongly deflexed ventrocaudad; in caudal aspect, ventral profile convex (feebly concave in median part in some specimens).

Oliarus montanus Metcalf is a member of the _O. placitus_ Van Duzee group. _O. montanus_ Giffard is a junior homonym and was given a new name by Metcalf (1936).

Oliarus montanus Metcalf is most likely to be confused with O. placitus, a species having much the same range in the eastern United States, but these two species are readily separated by the male terminalia, often without dissection. The apices of the styles of placitus are larger; the two very prominent, apically expanded, bilobate periandrial processes of placitus are diagnostic, as is the single long, slender, left apical process of the flagellum in placitus as compared to two such processes in the apical portion of montanus. Both O. placitus and O. montanus superficially resemble O. quinquelineatus (Say) and O. vicarius (Walker), but the last two species lack the greatly expanded pygofer process of the placitus group.

Variations have already been noted; the holotype terminalia are in agreement with the paratype which is illustrated.

The short, slender spine on the left ventral process of the periandrium of the paratype is papilliform in the holotype.

Metcalf listed the type material as follows: Holotype male, Black Mountains, N. C.; allotype female, Herndon, Virginia; paratype male, Craggy Mountains, N. C., and a male from Makanda. The state is not given for Makanda; however, I have located this specimen in the North Carolina State University collection and pencil script on the label appears to read "Ill." (Illinois). This specimen had no type label nor did the other specimens in the North Carolina State University collection which I believe to be the other paratype and the holotype. These specimens were in the line collection of North Carolina State, the Metcalf type cabinet not containing any

Oliarus montanus type specimens. I believe the holotype to be a male with the label "Black Mts., N. C. VI" machine printed except for the date. I have placed an F. W. Mead Specimen No. XI-3653 label on this specimen. One other apparently conspecific specimen was located at North Carolina State University, having the same information on the label as the presumed holotype. This other possible holotype is lacking the abdomen and parts of the tegmina. The male paratype from "Craggy Mts., N. C., 8-VI-1916, R. W. Leiby," was used to illustrate montanus in this present revision. This specimen has F. W. Mead Specimen No. XI-3651. The Makanda, Illinois, specimen has the date (in pencil), VI-4-'9; no collector label. This paratype has the head and body badly damaged. It has been labeled: F. W. Mead Specimen No. XI-3652.

Twenty-three male specimens were examined from 11 states in the eastern half of the country. The known range extends from New York south through Pennsylvania, Maryland, Virginia, North Carolina, and northern Georgia, north and west to Tennessee, Ohio, Illinois, Missouri, and eastern Kansas.

I place Oliarus montanus Metcalf in a distinctive group that includes O. eximus Caldwell, O. placitus Van Duzee, and O. teximus Caldwell. O. montanus is sympatric with placitus and allopatric to eximus and teximus. From the available information I think of montanus as a member of the Carolinean fauna with possible center of origin in the southern Appalachian Mountains.

The precise habitat information available on Oliarus montanus Metcalf is very limited. Labels read as follows, "on root of apple tree" [Malus sp.], "elev. 2000;" "light trap", and "on Hickory" [Carya]." Most of the specimens were collected in mountainous or hilly areas.

The known seasonal distribution is from May 22 to August 27, with most records being in June.

<u>OLIARUS</u> <u>EXIMUS</u> CALDWELL

Figures 1, 84, 85, 227, 228, 302, 340, 397, 398, 444, 489, 539

<u>Oliarus</u> <u>eximus</u> Caldwell, 1947. Pan-Pac. Ent. 23:145-146.

Length of male 5.3 mm to 6.4 mm (based on nine specimens); holotype male 5.9 mm. Vertex and mesonotum varying from fuscopiceous to castaneous; mesonotal carinae varying from brown to orange, usually a concolorous brown, no single specimen with all five carinae a prominent orange. Head: Vertex moderately broad, length in middle line equal to width at apex of posterior emargination; median carina nearly obsolete or short. Face usually castaneous, commonly tinged fuscous or yellow-brown in certain areas; facial carinae prominent, especially the median carinae which is percurrent and yellowish entire length, base with unusually long and prominent fork; maculae present but reduced, somewhat crescent-shaped; frons broad, width substantially greater than length in middle line (1.47 to 1.66:1). Rostrum long, usually surpassing caudal margin of posterior trochanters; in some specimens extending past posterior trochanters by half length of apical segment of rostrum, in other specimens approximately even with caudal trochanteral margin.

Thorax: Pronotum with intermediate carinae separated from posterior margin. Mesonotum with all carinae prominent. Tegmina strikingly marked throughout with intermixed white and brown veins, spotting weakly extending to some membranous areas; a small brown spot usually at fork of Y-vein but spot nearly obsolete in some specimens; apical crossveins vicinity of M and Cu usually with brownish suffusion; apical crossveins of Sc and R pale or light brown, not suffused; commissure mostly dark with adjoining membrane of clavus variously fumose with brown, pale area of commissure located at union of claval veins; tubercles large, mixed pale and pigmented, tending to be concolorous with veins; however, some pale veins with pigmented tubercles, numbers of apical cells variable among specimens and between left and right tegmina of individual specimens, range of variability extending from 9 to 12 cells, with 10 and 11 cells most common; anteapical cells varying from 3 to 7, with 6 the normal number (in a specimen with 3 anteapical cells on one tegmen and 4 on the other tegmen the small number resulted from the lack of some apical crossveins); stigma brown, usually subtriangulate, moderately narrow, length two and one-half to three times width. Legs with each front tibia having two brown bands.

Male terminalia: Aedeagal complex as in figures 84 and 85; total pointed process three or four, plus sclerotized, thumblike lobe atypical of usual form of process. Periandrium with three prominent processes and one partially hidden, spinelike, basiventral process present in more than half the specimens examined; periandrium sufficiently modified to make difficult the discussion of dextral and sinistral processes in the context used in other descriptions; one prominent process developing on ventral side from basal area; this process curving left, then caudad, swollen at approximately midlength, then tapering to a point with slight outward curve, distinctly short of apex of flagellum; basiventral area often with a spinelike process directed to left or left-cephalad, basal portion of spinelike process hidden in ventral view (entirely hidden in dorsal view); periandrium in dorsal view with right dorsolateral and left dorsolateral processes, the process of the right side slender, longer, straight or nearly so, acuminate; the process of the left side extending left-caudad at approximately 45 degree angle to subapical portion which curves approximately 45 degrees abruptly caudad, tapering rather abruptly to a point, this process not reaching as far caudad as the other two prominent processes. Flagellum extended nearly straight caudad, slightly inclined to the left, without processes of the usual type but with a thumblike, subapical dorsal process directed primarily to the left but also somewhat cephalad; much of flagellum with a large platelike or keellike structure primarily on the ventral surface. Styles as in figure 1, 227, and 228; slightly asymmetrical; apical area bilobate; inner processes moderately short, somewhat fingerlike, slightly expanded at apices, right inner process directed caudad at an angle, left process not so. Connective short and stout; combined width of ventral areas a little less than twice the width of the base of the shaft in posterior aspect. Pygofer as in figures 340, 397, and 398; medioventral process in ventral view greatly expanded, nearly as wide as long, spatulate, constricted basally and broadly rounded apically, tending to be slightly asymmetrical, extending posteriorly slightly more than apices of pygofer lateral lobes; lateral lobes symmetrical or nearly so, rather thin in ventral view, greatly produced in lateral aspect, apices subacute and most produced extremely ventrally along the posterior margin. Anal segment as in figures 444, 489, and 539;

in dorsal view flaplike, considerably longer than wide, nearly symmetrical, medioapical margin slightly concave; in lateral view asymmetrical apically, the left caudoventral portion not expanded as much as the right caudoventral portion; in caudal view the ventral profile concave in median portion, subtended on each side by a protuberance or convexity.

Oliarus eximus Caldwell is an uncommon species of the southwestern United States. It is a member of the O. placitus Van Duzee group. It is closest to O. teximus Caldwell, under which distinguishing characters are discussed.

Probably the most important variation occurs in the presence or absence of a short, spinelike process partially hidden at the basiventral portion of the aedeagal complex. The holotype and most but not all of the type series have this process. A specimen from Inyo County, California, has the longest such process; a specimen from New Mexico lacks this process.

Caldwell listed the type series as "male holotype from Santa Rosa Mts., California, June 15, 1946; female allotype same locality, May 27, 1946; paratypes May 27, 1946, June 15, 1946, June 25, 1946 (D. J. & J. N. Knull), OSU" [Ohio State University]. I have examined what I presume to be the entire type series, including the holotype. In the United States National Museum I found a male having the same label data as the holotype, but this specimen had no paratype label. I am convinced it is a member of the original series. At Ohio State I found five male paratypes with red labels. The female series is mixed. Of the allotype and six paratypes, only one female is Oliarus eximus Caldwell (collecting date VI-25-46, F. W. Mead Specimen No. VIII-4673). The allotype female and the other female paratypes are not eximus but belong to the mountain form of O. californicus Van Duzee.

The simplest characters to separate females of Oliarus californicus from those of eximus are the intermixed white and brown veins in eximus; californicus has fairly uniformly brownish veins. O. californicus also has a broader, shorter face, large maculae, a much better developed median carina of the vertex, and less conspicuous mesonotal carinae.

Other specimens examined include a male from New Mexico, Andreas Bolter collection, Illinois Natural History Survey collection; a male from Inyo County, California, 12 miles northeast of Big Pine, 7200 feet above sea level, collected at night, VI-9-1966 (Lois B. O'Brien) and a female from "Forest Home", San Bernardino County, California, VI-14-28 (E. C. Van Dyke).

The known range of Oliarus eximus Caldwell is southern California and an unknown locality in New Mexico. No Arizona specimens are available in spite of the fairly intensive collecting done in that state.

Oliarus eximus Caldwell is one of four forms I have assigned to a compact group that includes O. placitus Van Duzee, O. montanus Metcalf, and O. teximus Caldwell. This group is more common in the eastern half of the United States and possibly is of southern Appalachian origin. I have seen no Mexican or Neotropical forms that closely resemble this group.

Oliarus eximus Caldwell appears restricted to very local mountainous areas of the southwestern United States from the very little information available. Collecting records start with May 27 and end with June 25.

OLIARUS TEXIMUS CALDWELL, NEW STATUS

Figures 81, 82, 83, 225, 226, 300, 301, 339, 396, 443, 488, 538

Oliarus eximus teximus Caldwell, 1947. Pan-Pac. Ent. 23:146.

Length of male 4.7 to 5.9 mm (based on six specimens); holotype male nearly 5.1 mm. Vertex and mesonotum fuscous to medium brown; mesonotal carinae usually concolorous, sometimes orange. Head: Vertex moderately broad, length in middle line about equal to width at apex of posterior emargination; median carina extending anteriorly to a variable extent, up to half the length of the disc. Face castaneous or yellow-brown, lighter than mesonotum; facial carinae prominent, yellowish, median carina percurrent and yellowish from base through anteclypeus and with unusually long and prominent basal fork; maculae present but of reduced type, somewhat crescent-shaped; frons broad, width greater than middle length, the length two-thirds to seven-tenths the width. Rostrum long, usually surpassing caudal margin of posterior trochanters; in some specimens extending beyond posterior trochanters more than half the length of apical segment of rostrum; in other specimens, approximately as far as caudal margin of trochanters.

Thorax: Pronotum with intermediate carinae separated from posterior margin. Mesonotum with all carinae prominent. Tegmina strikingly marked with brown spots at forks of Y-veins and with small brownish areas in several apical cells, at all apical cross-veins, and along commissure, and several segments or forks of the veins; tubercles mostly prominently pigmented with brown, but a few concolorous with pale vein sections and somewhat difficult to detect;

all lengthy veins intermixed with pale and dark sections; apical cells normally 12 in number, occasionally 11, and anteapical cells 6; stigma brownish, somewhat rounded, proportions variable, length usually two to two and one-half times width. Legs with front tibiae bearing alternating pale and dark bands, the latter two in number.

Male terminalia: Aedeagal complex as in figures 81, 82, and 83; total of conspicuous pointed processes four, plus a lobelike, lightly sclerotized structure. Periandrium with four prominent processes and occasionally with adventitious small subprocess; type specimen having four prominent processes of about equal length, two arising from the basiventral area, two arising from the basal left and right dorsolateral areas. Flagellum as a whole directed nearly straight caudad, slightly inclined to the left; without processes of the usual type but with a thumblike dorsal, subapical lobe directed to the left, this lobe moderately sclerotized, much of flagellum a large rigid, platelike structure primarily on the ventral surface. Styles as in figures 225 and 226; slightly asymmetrical; apical area weakly bilobate; inner processes moderately short, somewhat fingerlike, apex varying from acuminate to moderately rounded. Connective as in figures 300 and 301; unusually short and stout; combined width of ventral arms much wider (nearly two times) than width of base of shaft in posterior aspect. Pygofer as in figures 339 and 396; medioventral process in ventral view greatly expanded, approximately as wide as long or slightly longer than wide, rounded-spatulate, constricted basally, broadly subtruncate or truncate apically, extending posteriorly slightly more than level of apices of lateral lobes of pygofer; lateral lobes symmetrical or nearly so, rather thin in ventral aspect, greatly produced in lateral aspect, apices subacute and most produced extremely ventrally along the posterior margin. Anal segment as in figures 443, 488, and 538; in dorsal view flaplike, considerably longer than broad, symmetrical or nearly so, rather thin in ventral aspect, greatly produced in lateral aspect, apices subacute and most produced extremely ventrally along the posterior margin. Anal segment as in figures 443, 488, and 538; in dorsal view flaplike, considerably longer than broad, symmetrical or nearly so, medioapical margin slightly concave; in caudal view the ventral profile with a median rectilinear concavity bordered on each side by a ventral protuberance or convexity.

A change in status from a subspecies of Oliarus eximus Caldwell to a species is proposed for the concept previously known as Oliarus eximus teximus Caldwell. Differences between eximus and teximus are rather slight for the most part, but I separate the two primarily by the processes of the periandrium. Oliarus teximus has four prominent acuminate processes generally directed caudad, but eximus has only three such processes; however, some specimens of eximus have a short, spinelike process directed primarily to the left from a basiventral position.

Male terminalia serve to distinguish Oliarus teximus Caldwell from closely related species. O. teximus is a member of the O. placitus Van Duzee group, and the group characteristics are sufficient to separate teximus from non-group species without the necessity of dissections.

Oliarus teximus Caldwell exhibits infraspecific variation but no specimens were encountered that were interpreted as hybrids or intergrades with *O. eximus* Caldwell. One interesting type of variation is in the length of the four processes of the periandrium in *teximus*. The paratype from Uvalde County, Texas, and two male specimens from Hidalgo County, Texas, agree in the four processes being approximately equal in length. The holotype male from "Bastrop N. P." Texas and two males from Dallas, Texas, and Davis Mountains, Texas, agree in having an extraordinarily long, basal, medioventral process and the other three processes of slightly different lengths. The one long process distinctly extends posteriorly beyond the flagellum but the other processes do not extend as far as the apex of the flagellum. The specimen from Dallas, Texas, has an adventitious short, very slender, subprocess at the right basal position of the long, basal, medioventral process of the periandrium. The males with the unusually long process are from 4.7 to 5.1 mm in total length; the others with the processes of equal length are from 5.6 to 5.9 in length.

All the type material of *Oliarus teximus* Caldwell is in the Ohio State University collection and was examined by me. Caldwell listed the type series as, "male holotype from Bastrop, N. P., Texas, May 1, 1941; female allotype and male paratype, Uvalde County, Texas, May 3, 1941; female paratypes, Uvalde County, May 11, 1946, and Brownsville, Texas, May 8, 1935 (D. J. & J. N. Knull), OSU." The females do indeed appear conspecific with the males;

however, their sexual dimorphism is manifest in much larger brown areas on the tegmina.

Other specimens examined include one male and three females from Hidalgo County, Texas, IV-7-50 and one male from Hidalgo County, V-23-51; one female Uvalde County V-23-35; one male, one female Davis Mountains, Texas, VII-11-55, all the above specimens collected by D. J. and J. N. Knull in the Ohio State University collection. The other specimen is a male from Dallas, Texas, IV-25-07 (F. C. Pratt) #28, United States National Museum collection. It is evident that this is an uncommon species.

The known range of _Oliarus teximus_ Caldwell is confined to Texas where it ranges from Dallas County in the northeast quarter of Texas, south to the Lower Rio Grande Valley, and west to the Davis Mountains, the localities being widely scattered.

No host or habitat information is available for _O. teximus_ Caldwell.

The known seasonal distribution of _O. teximus_ Caldwell extends from April 7 to July 11, with most records in April and May.

OLIARUS LOBATUS CALDWELL

Figures 66, 67, 208, 209, 291, 330, 385, 435, 480, 530

Oliarus lobatus Caldwell, 1938. Ohio J. Sci. 38:305.

Length of male 7.0 to 7.8 mm (based on 24 specimens); holotype 7.5 mm. Ground color of vertex and mesonotum fuscous to castaneous; carinae of mesonotum predominantly dull orange, often blended with brown. Head: Vertex moderately broad, variable, length in middle line varying from slightly less than width at apex of posterior emargination in some specimens, to distinctly greater than width in other specimens; median carina absent or very short. Face usually castaneous; median carina conspicuously forked at base, percurrent, usually orange colored entire length; lateral carinae usually orange to pale yellow; maculae weakly to moderately developed, usually lineate or lunate; frons moderately narrow, width distinctly greater than length in middle line, variable. Rostrum length variable, extending posteriorly from slightly less than to slightly more than distance to caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae separate from pale border of hind margin. Mesonotum with all carinae conspicuous, somewhat variable. Tegmina with brownish spots of variable intensity; clavus with prominent brown spots at fork of Y-vein and usually half-way from fork to commissure; corium with spot near fork of Cu_1 and with brown patches in discal cells, thus forming (usually) a diagonal row of brownish patches to Y-vein fork; apical crossveins suffused, apical cells variously spotted with brownish areas; tubercles prominent, pigmented with brown, contrasting with the usually pale (sometimes light brown) veins, normally with 12 apical and 6 anteapical cells; stigma brown, shape variable, usually two to three times longer than wide. Legs with front and middle tibiae vaguely banded.

Male terminalia: Aedeagal complex as in figures 66 and 67; total pointed processes eight. Periandrium with five processes; dextral process prominent, sinuate basally, recurved outward apically (hooklike); no basal sinistral process, but left apical area with a short, straight process directed left caudad; ventral medioapical area giving rise to a short process, directed left-cephalad in some specimens, but in other specimens longer, with distal portion curving left dorsocaudad; ventral, right, submedioapical area giving rise to a prominent retrorse process which usually curves approximately 90 degrees to the left in apical third, but curvature much less in some specimens; left apical area, primarily on dorsal surface, with a moderately long, slender process directed left-cephalad, with apical part of process hidden by flagellum in ventral view. Flagellum appearing to make a complete loop when viewed ventrally; with three processes, an apical, preapical, and prebasal outer process which is longest of the three. Styles as in figures 208 and 209; symmetrical; apical portion greatly enlarged, producing a large flat, lateral lobe; inner processes far removed from posterior end of styles, fairly short, stout, beaklike or hooklike. Connective as in figure 291; long and slender; combined width of ventral arms approximately equal to width at base of shaft in posterior aspect. Pygofer as in figures 330 and 385; nearly symmetrical; medioventral process in ventral aspect small, slightly constricted at base, triangulate, width approximately two-thirds the length; process extending posteriorly distinctly less than half the distance to level of the apices of lateral lobes of pygofer; left lateral lobe slightly longer than right lateral lobe; in lateral aspect lobes broadly pointed, somewhat obliquely truncate, extending farthest caudad near midlength of posterior margin. Anal segment as in figures 435, 480, and 530; in dorsal aspect substantially longer than wide, symmetrical or nearly so, broadest near midlength, medio-apical margin concave between pointed lateroapical lobes; ventral profile in caudal aspect sinuate between a pair of short submedian pointed protuberances; lateral margins straight, not curving downward; thus, flaplike rather than hoodlike.

Oliarus lobatus Caldwell is a member of the *O. aridus* Ball group and is closest to *O. habeckorum*, new species, within that group. Diagnosis of *lobatus* is dealt with under the discussion of *habeckorum*.

Caldwell listed the type series as: male holotype, Davis Mountains, Texas, VIII-36; female allotype, Davis Mountains, Texas, VI-36; paratypes, Davis Mountains, Texas, and Huachuca Mountains, Arizona, 1936 and 1937; 1936 material collected by J. N. Knull; 1937 material collected jointly by J. N. Knull and Mrs. Knull (Dr. D. J. Knull). The type repository was listed as the Ohio State University collection. I have examined the following members of the type series. Ohio State University collection: Holotype male Davis Mountains, Texas, VIII-22-36, (J. N. Knull); 17 male and female paratypes from Davis Mountains, Texas, having the dates of VII-6-36, VIII-22-36, VI-2-37, VIII-2-37. At the United States National Museum collection (all paratypes from Davis Mountains, Texas): male, two female VII-6-36; male VIII-22-36; male VI-2-37; male VIII-2-37. I have not located any paratypes from Huachuca Mountains, Arizona, nor have I seen any other specimens from Arizona that were not paratypes.

The known range of _Oliarus lobatus_ Caldwell is limited to the Big Bend area (Brewster County) and Davis Mountains (Jeff Davis County) of Texas and to Whites City, New Mexico (Eddy County), about 12 miles north of the Texas border, due north of the Davis Mountains.

No specific habitat or host information is available for _O. lobatus_ Caldwell but this species seems restricted, for the most part, to isolated mountain groups of the west Texas area.

The known seasonal distribution of _O. lobatus_ Caldwell extends from June 2 to August 22.

OLIARUS CALDWELLI, NEW SPECIES

Figures 64, 65, 206, 207, 289, 290, 329, 383, 384, 434, 479, 529

Length of male 5.9 to 7.0 mm (based on four specimens); holotype male 6.2 mm. Ground color of vertex and mesonotum fuscous to fusco-piceous, area between mesonotal carinae variously mixed with orange; mesonotal carinae predominantly orange; on some specimens carinae all or partly brownish. Head: Vertex moderately broad, length in middle line equal to width at apex of posterior emargination in holotype, length slightly greater than width in paratypes; median carina in holotype and most paratypes present in basal half of disc. Face castaneous to fuscous; median carina with conspicuous long fork at base, percurrent distally through anteclypeus, color deep orange to pale yellow; lateral carinae pale from base through postclypeus; maculae weakly to moderately developed, usually linear or lunate; frons moderately narrow, ratio width to length 1.24 - 1.31:1. Rostrum long, distinctly surpassing caudal margin of posterior trochanters by one-fourth to one-third length of apical segment of rostrum; apical segment almost entirely fuscous.

Thorax: Pronotum with intermediate carinae not joining pale border of posterior margin; lateral area near tegula with a pale yellow, conspicuous, longitudinal carina connecting intermediate and posterior carinae; tegula predominantly light brown. Mesonotum with prominent carinae; intermediate pair well developed posterior half or two-thirds of mesonotum, evanescent in anterior quarter, mostly arcuate. Tegmina milky subhyaline, clavus with fuscous spot vicinity of Y-vein fork and another half the distance from Y-vein fork to commissure; commissure brownish to testaceous basad of juncture of Y-veins, pale for a short distance distad Y-vein juncture; an occasional specimen with small spot at Cu_1 fork and again on media near Cu_1 fork; costal cell with three well spaced fuscous spots, tending to lie closer to costa than to subcosta; apical crossveins infuscated and most apical cells with brownish areas or spots; tubercles prominent, more so than in most species of genus, usually brown pigmented and contrasting with the pale yellow veins in the basal half or so of the tegmina, apical veins darker; normally with 11 apical cells and 6 anteapical cells; branches reaching apex: Sc two, R two M five, Cu_1 two; stigma brown, with length two to two and one-half times the width. Legs with front and middle tibiae vaguely banded.

Male terminalia: Aedeagal complex as in figures 64 and 65; total pointed processes seven. Periandrium with four processes; dextral process moderate in size, apical two-thirds directed nearly straight caudad and slightly to the right; no basal sinistral process; left ventroapical area with a fairly short, acute process directed straight left; ventral, right, submedioapical area giving rise to a retrorse process having the apical fourth recurved to the right, hooklike; dorsal periandrium with a short, slender, straight process directed left from the right apical area. Flagellum appearing to make a complete loop when viewed ventrally; with three processes: one apical and fairly stout, a second dorsal preapical, slender, and a third prebasal outer process, longer than others and directed nearly straight cephalad. Styles as in figures 206 and 207;

symmetrical, or nearly so; apical portion greatly enlarged, produced in large, flat subrectangulate, lateral lobe; inner processes far removed from posterior end of styles, fairly short, stout, with apices curving inward from position on outer, basal shoulder of lobe. Connective as in figures 289 and 290; long and slender, shaft nearly straight in lateral aspect; combined width of ventral arms slightly more than width of shaft in posterior view; pygofer as in figures 329, 383, and 384; nearly symmetrical; medioventral process in ventral aspect short, constricted at base, triangulate, ratio of width to length 7:11, extending posteriorly less than half the distance to level of apex of left lateral lobe; left lateral lobe slightly longer than the right lobe; in lateral aspect lobes broadly pointed, left lobe gently convex ventrad of most posterior part of margin, but right lobe straight (obliquely truncate) ventrad of most posterior part of margin; apex of each posterior margin occurring at midlength. Anal segment as in figures 434, 479, and 529; in dorsal view slightly asymmetrical; medioapical margin convex; substantially longer than wide, flaplike, ratio of length to width in holotype 1.7:1, with widest portion at or near middle; in caudal aspect, asymmetrical, ventral profile undulate, with left submedian lobe extending farther ventrad than right submedian lobe.

Oliarus caldwelli, new species, is very close to O. lobatus Caldwell, with which it has been previously identified. The external appearance is much the same, but caldwelli is usually smaller than lobatus and has three fuscous spots in the costal cell of the tegmen which are not present in lobatus. This character is very useful in separating females of these two species and also in separating *caldwelli* from similar members of the *O. aridus* Ball group. *O. caldwelli* and *O. lobatus* can be separated from many of the southwestern species by the heavier, more prominent tubercles on the veins of the tegmina and also by the narrower head. Every major structure in the male terminalia of *caldwelli* and *lobatus* exhibits differences between these two species. The periandrium of *caldwelli* has four processes, in *lobatus* there are five processes; the ventral retrorse process of *caldwelli* curves to the right near its apex, but in *lobatus* it curves to the left; the dextral process of *caldwelli* is nearly straight, but in *lobatus* is recurved. The apical process of the flagellum in *caldwelli* is stouter than its counterpart in *lobatus*. The greatly expanded lateroapical lobes of the styles are longer and narrower in *caldwelli* than in *lobatus*, and the position and shapes of the inner processes are correspondingly different. There are differences in the respective shapes of the anal segments whether viewed dorsally, laterally, or posteriorly.

Oliarus caldwelli, new species, is described from the male holotype, female allotype, two male paratypes and one female paratype all from 20 miles south of Alpine, Texas [Brewster County], May 12, 1927, (J. O. Martin) California Academy of Sciences collection; a male paratype from Ft. Davis, Texas [Jeff Davis County], #13, June 6, 1933 (P. W. Oman), United States National Museum collection; and a male paratype from Jeff Davis County, Texas, July 12, 1950, (D. J. and J. N. Knull) Ohio State University collection. The holotype has the label with F. W. Mead Specimen No. III-8671; the allotype has F. W. Mead Specimen No. III-20673 label.

Oliarus caldwelli, new species, and the closely related *O. lobatus* Caldwell are sympatric; both are known only from the Big Bend - Davis Mountain areas of western Texas, except for one slightly atypical specimen of *lobatus* which has been taken in New Mexico, approximately 12 miles north of the Texas state line.

Oliarus caldwelli, new species, along with the very closely related *O. lobatus* Caldwell, appear to be members of the *O. aridus* group, but not as close to *aridus* as some of the other species within the group.

No specific habitat or host data are available for *O. caldwelli*, new species. Specimens have been collected from May 12 to July 12.

This species is named in honor of Dr. John Stein Caldwell, Circleville, Ohio, who has contributed so much to our knowledge of Homoptera.

OLIARUS APACHE BALL

Figures 60, 61, 202, 203, 287, 327, 381, 477, 527

Oliarus apache Ball, 1934. J. Wash. Acad. Sci. 24:275-276 (Key: 270-271).

Oliarus apache; Ball, 1938. Bull. Brooklyn ent. Soc. 32:180-181 (Comparative note).

Length of male 4.0 to 4.6 mm (based on 21 specimens). Ground color of vertex and mesonotum usually piceous, sometimes fuscous; mesonotal carinae concolorous to dull orange. Head: Vertex narrow, the length in middle line greater than the width at apex of posterior emargination, usually by 1.4 to 1.6:1; median carinae absent or very short. Face with ground color fuscocastaneous to nearly piceous; median carina orange, distinctly forked at base; lateral carinae lighter and usually pale yellow; carinal light color usually much more conspicuous on frons than clypeus and on some specimens confined to frons, but on others fairly conspicuous on postclypeus; maculae small, indistinct; frons rather broad, its length in middle line only about two-thirds width. Rostrum short, distinctly failing to attain caudal margins of posterior trochanters.

Thorax: Pronotum with intermediate carinae usually not attaining pale band of hind margin but sometimes becoming tangential or joined by calloused area; some specimens (from California) with intermediate carinae briefly interrupted at posteriormost part of curve. Mesonotum with intermediate carinae weaker than other carinae, becoming obsolete in some specimens, these specimens appearing tri-carinate. Tegmina varying from nearly immaculate to having numerous small spots or dark areas; small spots usually present at fork of Cu_1, fork of M, and at all apical crossveins; some specimens with membrane partially smoky brown in discal area; veins usually whitish throughout, but some specimens with apical veins brownish and with certain other veins brownish if near fumose areas of the membrane; tubercles numerous, large, and very conspicuous because of fuscous pigment which makes them stand out against the white veins; apical cells variable, usually 11, and anteapical cells almost always 6; stigma varying from white to brown, partially darkened by heavy brown punctures along boundary vein, weakly developed, subtriangulate and short, less than twice as long as wide. Legs with tibiae unusually pale, front tibiae with narrow brown band basad, successively followed distally with a broad pale band, a broad, poorly defined brownish area, and a narrow, pale band at apex.

Male terminalia: Aedeagal complex as in figures 60 and 61; total pointed processes six. Periandrium with three processes; dextral process long and slender, attaining level of aedeagal joint, process straight in some specimens, sinuate in others, right-lateral in position, usually adjacent to aedeagal complex and sometimes partly hidden in ventral view, mostly hidden in dorsal view; sinistral process wanting, no more than a swollen area; left lateral apex of periandrium with long, slender, sinuate process variously directed left ventrocephalad; dorsal periandrium with a retrorse process at the extreme left apical area, stout basally, becoming acuminate apically. Flagellum appearing to make a complete loop, in ventral aspect; with three processes: a pair of apical processes with the outer one a rather typical, moderate-sized pointed process, the other apical process atypically expanded, stout, somewhat molarlike in profile in most specimens; loop of flagellum, on outer left margin, having an acuminate process, short in some specimens, moderate in length and rather slender in other specimens. Styles as in figures 202 and 203; asymmetrical; each shaft moderately long, slender, and comparatively straight; _in situ,_ left style appearing larger apically and having an apical notch near point of attachment of inner process; also _in situ,_ the left apex of right style with a convexity that fits into an adjacent subapical recess of the left style; recurved portion of each style making an approximate right angle with shaft; inner processes long, curving, slender structures, process of left style arising from apex of shaft, process of right style arising from subapical area. Connective as in figure 287; rather stout; combined width of ventral arms slightly more than width of base in posterior aspect.

Pygofer as in figures 327 and 381; medioventral process in ventral aspect elongate-triangular, broadest at basal area, apex bluntly pointed; process extending posteriorly over half the distance to level of apices of pygofer lateral lobes; lateral lobes moderately produced, extending farthest caudad distinctly below ventrad of midlength of posterior margins; lobes symmetrical with apices slightly undulate in lateral aspect, but in ventral aspect with main axis of each lobe directed straight caudad. Anal segment as in figures 432, 477, and 527; in dorsal view, appearing rounded and distinctly longer than wide (width approximately five-eights length); nearly symmetrical, but the right side slightly more expanded than the left; medioapical margin slightly concave; basal points of attachment of anal segment more prominent than usual; in caudal view, ventral profile nearly straight from left margin to well towards right margin, but latter produced more right-ventrad; therefore, distinctly asymmetrical with left half of profile.

Oliarus apache Ball, a member of the O. aridus Ball group, is one of the more striking Nearctic species. It usually can be identified in either sex by the numerous, heavily pigmented punctures contrasting with the pale veins of the tegmina. The species closest to apache, both in general appearance and male terminalia, is O. retentus Caldwell. Whitish veins predominate in the tegmen of apache with few exceptions, whereas the veins of retentus vary from pale yellow to brown. In apache, the tubercles are more conspicuous than on retentus and the lateral carinae of the basal half of the vertex are parallel or nearly so; the lateral carinae are divergent basally in retentus. The periandrium of retentus has a long, slender sinistral process which is lacking in apache. O. apache also is similar to O. sementinus Ball and O. canyonensis, new species, but the last two species have a much broader vertex and lack the white veins and extra prominent tubercles of the tegmina present in apache. O. pygmaeus Ball has whitish veins and prominent punctures and generally resembles apache, but apache has a broader vertex than pygmaeus. The latter has a brown spot immediately basad of the stigma which is not present in apache. O. eximus Caldwell is another southwestern species that resembles apache, but the tubercles are not as prominent on eximus, and the veins are greatly intermixed white and dark, compared to a fairly even white in apache. The unusually small, white to light brown stigma of _apache_ is another distinguishing character. The male terminalia of _apache_ serve to distinguish it from males of all other species I have seen.

The holotype female, allotype male, and four paratypes collected May 15, 1933, and nine paratypes collected May 19, 1929, were all taken by E. D. Ball at Tucson, Arizona. I have seen, in the United States National Museum, all the May 15, 1933, specimens and at least three paratype males from the May 19, 1929, lot. All these specimens are conspecific and in essential agreement with Ball's description of _Oliarus apache._ The pin with the red E. D. Ball holotype label has three females glued to the paper point. The specimen on the tip of the point is partly missing with only the head and part of the thorax still attached to the glue. The pin with the red E. D. Ball allotype label has a paper point with three specimens glued to it. The specimen next to the pin is a female: the other two are males.

Other specimens examined were from MEXICO: Sonora: Hermosillo; UNITED STATES: Arizona: Cochise, Maricopa, Pima, Pinal, Santa Cruz, Yavapai, and Yuma Counties; California: Inyo, Riverside, and San Diego Counties.

Ball (1934) stated that the habitat of _O. apache_ was "Creosote deserts around Tucson, at Patagonia and Tinajas Altas in Ariz. and near Hermosillo, Mexico." The highest altitude record available is 6300 feet at 9 miles northeast of Big Pine in Inyo County, California, where _apache_ was collected at night by Lois and Charles W. O'Brien. At Deep Canyon, Riverside County, California, several specimens were collected at light by E. I. Schlinger and M. Irwin.

The seasonal distribution of *Oliarus apache* Ball is fairly extensive. Months on the labels include March through June, August through October, and one December record.

OLIARUS KNULLORUM, NEW SPECIES

Figures 49, 50, 51, 190, 191, 282, 321, 374, 375, 427, 472, 522

Length of male 4.7 to 5.6 mm (based on 13 specimens). Ground color of vertex and mesonotum varying from fuscopiceous to castaneous, usually fuscous; mesonotal carinae somewhat variable, usually orange or yellowish brown. Head: Vertex variable in width, usually moderately broad, with length in middle line barely greater than width at posterior emargination (holotype 25:24), but some specimens with vertex narrower or fairly broad (ratio length to width in 17 specimens varying from 1.28:1 to 1:1.22); median carina conspicuous on basal half of disc. Face fuscous to castaneous; median carina orange, broadly forked at base, the resulting triangular area enclosed by feebly elevated or obsolete carinae; median carina traversing length of frons and clypeus but less elevated on post-clypeal part of clypeus; lateral carinae narrowly pale yellow or yellowish brown throughout length; each macula conspicuously present as a distinct, pale yellow, oblong spot; frons unusually broad, with width approximately twice as great as length in middle line (holotype 54:26). Rostrum fairly long, usually slightly surpassing posterior trochanters.

Thorax: Pronotum with intermediate carinae usually narrowly separately from pale band of posterior margin. Mesonotum with carinae moderately and equally conspicuous. Tegmina translucent in most specimens but some having most of basal half of each tegmen a dark smoky brown; spotting quite variable, some specimens appearing immaculate, others heavily spotted; spots usually visible at fork of Y-vein, fork of Cu_1, and distal crossveins; occasionally a few cells with smoky brown patches; tubercles moderately large, but not conspicuous, concolorous or nearly so; with veins; veins brownish distally, becoming mostly yellowish or yellowish brown in the basal two-thirds of tegmina in some specimens, but in other specimens with most veins brownish; costa testaceous in nearly all specimens; apical branching of veins variable, usually resulting in 11 or 12 apical cells and six anteapical cells; stigma variable, usually light brown and with length approximately three times width. Legs fuscous basally, usually yellowish or testaceous distally, front and middle tibia indistinctly banded with brownish bands at ends of segment and separated by broad brownish yellow band.

Male terminalia: Aedeagal complex as in figures 49 and 51; total pointed processes eight, not counting forks. Periandrium with five processes; dextral process moderately long, directed right-caudad, nearly always distinctly forked at or near midlength (figure 50) (one specimen observed to have fork nearly obsolete); sinistral process short, acute, nearly straight, directed to the left and ventrocephalad; right-lateral, basiventral area with a moderately short, very slender process directed caudad primarily; apicoventral area with a conspicuous process usually directed caudad initially, then curving to the left, (an atypical process has been observed to continue primarily caudad and somewhat to the left for full length); dorsal periandrium with a moderate-sized, slender, acute, retrorse apical process directed primarily cephalad and somewhat right-ventrad. Flagellum in ventral aspect appearing to make a complete loop; with three processes; apically with two long slender subequal processes; outer midlength of flagellum with long, conspicuous, fairly slender process lying adjacent to dorsal surface of flagellum for most of its length; no process on inner margin of flagellar loop. Styles as in figures 190 and 191; nearly symmetrical; each shaft moderately long and slender; apex expanded and somewhat angulately recurved through more than 90 degrees; inner processes nearly symmetrical, moderately long, slender, and curved: left process slightly thicker. Connective as in figure 282; comparatively short and stout; combined width of ventral arms not quite as great as width of base in posterior aspect. Pygofer as in figures 321, 374, and 375; slightly asymmetrical; medioventral process slightly longer than wide, constricted basally, widest subbasally, abruptly narrowed distally, and with apex semiacute; extending posteriorly distinctly less than half the distance to level of apex of left pygofer lobe; left pygofer lobe slightly longer than right lobe; in lateral aspect lobes well produced, left lobe with apex more produced and acute than apex of right lobe, apices occurring somewhat ventrad of midlength of posterior margin, with lower margin curving irregularly ventrocephalad. Anal segment as in figures 427, 472, and 522; in dorsal view symmetrical or nearly so, distinctly longer than wide (ratio of length to width in holotype 49:33); medioapical margin convex; in caudal aspect ventral profile gently concave.

Oliarus knullorum, new species, is a member of the *O. aridus* Ball group and is a relatively uncommon species in the southwestern

United States. In external appearance and in male terminalia knullorum resembles O. pima Kirkaldy, but pima is larger (6.0-7.5 mm) than knullorum (4.7-5.6 mm). The flagellum of pima has an inner process, but knullorum has no inner process of the flagellum. This lack of a process on the inner portion of the flagellar loop is one of the best characters for separating knullorum from O. californicus Van Duzee and from O. kieferi, new species, with which it has been confused in the past. Only one other species in the aridus group, O. lobatus Caldwell, has the combination of five periandrial processes (not counting forks) and three flagellar processes, but lobatus has the periandrium with a retrorse process ventrally but not dorsally; the reverse is true of O. knullorum.

The most conspicuous variations were observed in two males and two females from Davis Mountains, Texas. These specimens had a distinctly broader vertex than other members of the type series from Texas and Arizona. There was also greater variation in the male genitalia of the specimens from Davis Mountains.

Oliarus knullorum, new species, is described from the male holotype from Chisos Mountains [Brewster County] Texas, June 9, 1939 (D. J. and J. N. Knull), F. W. Mead Specimen No. I-26673; female allotype from Chisos Mountains, Texas, July 17, 1946 (D. J. and J. N. Knull); and the following 30 paratypes: ARIZONA: Cochise County: Chiricahua Mountains, Rustlers' Park [map elevation 8,420 feet above sea level] 7-5-40, one male (D. E. Hardy) and one male (L. C. Kuitert), University of Kansas collection; Chiricahua Mountains, VII-14-36 (J. N. Knull) one male and one female United

States National Museum, and one male same data, Ohio State University collection; Cochise or Santa Cruz County: Huachuca Mountains, 6-15-30 (E. D. Ball), four males and five females, United States National Museum; Pima or Santa Cruz County: Santa Rita Mountains, June 12, 1933 (P. W. Oman) three males, and four females; Santa Rita Mountains, 7-11-32 (E. D. Ball) one male; Yavapai County: Granite Dells, 6-29-1933 (P. W. Oman) one male; TEXAS: Brewster County, Chisos Mountains, VI-9-36, (J. N. Knull) one female, and another female VII-17-46 (D. J. and J. N. Knull), Ohio State University collection; Chisos Mountains, VII-17-46 (D. J. and J. N. Knull) one male, United States National Museum collection; Jeff Davis County: Davis Mountains, VIII-22-36 (J. N. Knull) two males and one female, Ohio State University collection, and one female United States National Museum.

The known range of _Oliarus knullorum,_ new species, is confined to isolated mountain ranges of Arizona and southwestern Texas. It is estimated that most of the specimens were collected at altitudes between 5,000 and 8,500 feet above sea level. The only host label on any of the specimens is "Junip." [_Juniperus_] on specimens from Huachuca Mountains, Arizona.

The collecting dates for _Oliarus knullorum_ range between June 9 and August 22.

This species is named in honor of Josef N. Knull, Emeritus Professor of Entomology, the Ohio State University, and his wife, Dr. Dorothy Johnson Knull. Their dedicated collecting has contributed much to our knowledge of American _Oliarus_ and other insects.

OLIARUS RETENTUS CALDWELL

Figures 56, 57, 198, 199, 285, 325, 379, 430, 475, 525

Oliarus retentus Caldwell, 1947. Pan-Pac. Ent. 23:148.

Length of male 3.6 to 5.1 mm (based on 10 specimens). Ground color of vertex and mesonotum fuscous to piceous; mesonotal carinae varying from concolorous with ground color or nearly so in some specimens to dull yellowish brown in other specimens, rarely with all carinae of a given specimen completely dark or light. Head: Vertex unusually narrow, width at apex of posterior emargination usually two-thirds the length at middle line; median carina usually present, variable in elevation, length, and contrast. Face fuscous to piceous; median carina with small but distinct fork at base, prominent on frons, less so on postclypeus, often partly obsolete or indistinct on the postclypeus; color of median and lateral carinae pale yellow to brownish yellow on frons, somewhat darker and narrower on postclypeus; face without distinct maculae but pale color of lateral carinae slightly extending onto epistomal suture in most specimens and suggestive of reduced maculae in a few specimens where pale color is broader; frons fairly broad, width substantially greater than length in middle line. Rostrum short, failing to attain caudal margin of posterior trochanters.

Thorax: Pronotum with intermediate carinae usually tangential to pale border of posterior margin. Mesonotum with carinae prominent, intermediate pair variable, tending to be obsolete or less elevated in anterior portion. Tegmina with membrane milky subhyaline in most specimens but vaguely smoky in some; spotting confined primarily to moderate infuscations at apical crossveins; some specimens with weak spot at fork of Cu_1; commissure weakly embrowned basad of Y-vein juncture; tubercles brown and prominent; veins usually pale yellow or light yellowish brown on basal two-thirds, brown on apical third; apical cells normally 11 and anteapical cells 6; stigma variable, pale in some specimens but usually brownish, with length approximately twice the width. Legs generally brown or brownish yellow, without distinct banded pattern.

Male terminalia: Aedeagal complex as in figures 56 and 57; total pointed processes six, counting any forked process as one. Periandrium with three processes, not counting any forks; dextral process extending caudad primarily, unusually long and slender, apex usually the most posterior part of aedeagal complex; sinistral process moderately long and slender, extending left-caudad, then abruptly recurving to dorsoanterior direction; left ventroapical area giving rise to acute, moderate-sized process (best seen dorsally) that extends left only a short distance before recurving dorsally and to the right; this process entire in some specimens but in other specimens giving rise to small fork at midlength; no process arising strictly from dorsal surface. Flagellum, in ventral aspect, appearing to make complete loop; with two apical processes (outer one slightly stouter) and one preapical, moderate-sized process, the latter visible only in dorsal view. Styles as in figures 198 and 199; long and slightly asymmetrical; shafts prominently expanded near midlength, narrowed subapically before apical expansion and recurvature; recurved portion somewhat angulate and thumblike; inner processes asymmetrical, slender, fingerlike, left process distinctly longer than right process and slightly broader. Connective as in figure 285; moderately long and stout; combined width of ventral arms distinctly greater than width of base in posterior aspect. Pygofer as in figures 325 and 379; symmetrical or nearly so; medioventral process in ventral aspect slightly longer than wide, broad basally, abruptly narrowed at midlength, apex acute; extending posteriorly approximately half the distance to level of apices of pygofer lateral lobes; lateral lobes unusually stout, moderate in length in ventral view; lobes in lateral view moderately produced, apical portion truncate. Anal segment as in figures 430, 475, and 525; in dorsal view symmetrical or nearly so; broad, but length somewhat greater than width; medioapical margin straight or nearly so; in caudal view, ventral profile broadly and shallowly concave.

Oliarus retentus Caldwell is an uncommon member of the *Oliarus aridus* Ball group. *O. retentus* is a distinctive species apparently not close to any known species; it most greatly resembles *O. apache* Ball, *O. canyonensis*, new species, and *O. papagonus* Ball. Specimens of *retentus* are normally the smallest within the *aridus* group of species; however, there is occasional overlap in size with specimens of other species in the group. Normally, the vertex of *retentus* is the narrowest of the *aridus* group. *O. retentus* is one of the few species in the group without an inner process on the loop of the flagellum. Normally, the dextral process of the periandrium of *retentus* is the longest in the *aridus* group, and it is unforked, which alone distinguishes it from approximately half the species in the group. The low number of periandrial processes (three), in addition to their position and shape, is diagnostic.

Caldwell listed the type series of Oliarus retentus as, "Male holotype, female allotype, and 11 paratypes from Nogales, Arizona, September 1906, (Koebele), CAS." This implies that the entire type series of O. retentus was deposited in the California Academy of Sciences but there are paratypes in the United States National Museum from which I examined two males and three females. I also examined two male paratypes sent on loan from the California Academy of Sciences. Dr. Paul H. Arnaud, Jr., has assured me that the holotype, allotype, and remaining paratypes are in the California Academy of Sciences collection at San Francisco.

Other specimens examined were from ARIZONA: 11 miles west of Williams, Coconinus County, September 7, 1964, (L. and C. W. O'Brien) elevation 1100 feet; Gila County, 25 miles northeast Seneca, September 10, 1964 (L. and C. W. O'Brien), elevation 5800 feet; Yavapai County, 4 miles north of Prescott, September 6, 1962 (C. W. O'Brien); COLORADO: Grand Junction, August 15, 1936 (J. D. Beamer); UTAH: Kanab, September 7, 1934 (E. D. Ball).

With the exception of the Grand Junction, Colorado, specimen (August 15), all known specimens of Oliarus retentus Caldwell have been collected during the month of September.

OLIARUS CANYONENSIS, NEW SPECIES

Figures 29, 31, 54, 55, 194, 195
196, 197, 323, 324, 377, 378, 429, 474, 524

Length of male 4.2 to 5.9 mm (based on two specimens); holotype 4.2 mm. Ground color of vertex and mesonotum fuscous to yellowish brown; mesonotal carinae brownish yellow. Head: Dorsum as in figure 29; vertex diverging posteriorly and unusually broad, ratio of length in middle line to width at apex of posterior emargination 1:1.50 in holotype, 1:1.38 in paratype; median carina prominent, extending anteriorly approximately two-thirds to three-fourths the length of disc; frontal carina a fairly broad, nearly straight, yellowish bar. Face a uniform, medium brown color or moderately dark brown; texture slightly rugose throughout frons and postclypeus, moderately shiny; median carina with large triangular fork at base, percurrent and yellowish to rostrum; median ocellus prominent, wider than median carina; lateral carinae moderately prominent and yellowish to apex at postclypeus, yellowish margin slightly expanded near epistomal suture and narrowly following it for a short distance, thereby suggesting feeble maculae; fenestrae prominent; frons broad, ratio of width to length in middle line 1.48:1 in holotype, 1.41:1 in paratype. Rostrum long, exceeding caudal margin of posterior trochanters by approximately half the length of the apical segment of the rostrum in the paratype, more so in the holotype (apical segment approximately four-fifths of its length past posterior trochanters); rostrum yellowish basally, apical segment mostly brownish.

Thorax: Dorsal view as in figure 29; pronotum with intermediate carinae narrowly separated from pale band of posterior margin; shoulder of pronotum with prominent carina along lateral margin; all carinae yellowish. Mesonotum with tegulae yellowish; carinae equally prominent, intermediate pair arcuate. Tegmina with venation as in figure 31; with conspicuous, irregular brown spots on clavus and corium; clavus with spots at Y-vein fork, juncture of Y-vein with commissure, and approximately midlength between these two spotted areas; corium with spots at fork of Cu_1 and middle areas of anterior and posterior discal cells; other spots at middle and apical cross-veins, most apical cells, and in middle apical cell; tubercles abundant, prominent and brownish, contrasting well with veins which are primarily yellowish, but occasionally embrowned adjacent to spotted areas; holotype with apical branching as follows: Sc two, R two, M five, Cu_1 two; apical cells 10 and anteapical cells 6; paratype apical branching as follows: Sc two, R three, M five, Cu_1 two; apical cells 12 and anteapical cells 6; stigma light brown and with length approximately two and one-half to three times width. Posterior wings with R not forked in holotype, forked once in paratype; M with three branches and Cu_1 with two branches reaching apex in both holotype and paratype; paratype with triangle formed by first radius and radial sector shorter than triangle formed by first and second media. Legs typically a rather uniform brown on basal segments, becoming yellowish distally; front and middle tibiae vaguely twice brown-banded.

Male terminalia: Aedeagal complex as in figures 54 and 55; total pointed or semipointed processes seven. Periandrium with four processes; dextral process thick, straight, and truncate, not attaining level of aedeagal joint, irregularly serrate on apex and inner margin; sinistral periandrial mass developing into two unpaired slender processes (or subprocesses), the outer left process approximately one-half the length of the inner right process; both of these processes directed primarily caudad, the longer process curving slightly to the left, the shorter one straight or curving slightly to the right; left ventro-apical area with a long, slender process directed left then curving cephalad and right-cephalad; dorsal periandrium without a process. Flagellum appearing to make complete loop from ventral aspect, three well-spaced processes, all slender, acute, and moderate in length, one at outer midlength of flagellar loop, one preapical and on outer part of loop, and one apical; no process on inner part of loop. Styles as in figures 194, 195, 196, and 197; each shaft fairly slender, its apex expanded and irregularly recurved into an anterolateral, thumblike lobe; inner processes asymmetrical, left process much shorter than the right process, both acute. Connective as in figure 284; moderately long and slender; combined width of ventral arms slightly greater than width of base in posterior aspect. Pygofer as in figures 323, 324, 377, and 378; symmetrical or nearly so; medioventral process in ventral aspect long and slender, broadest next to slight basal constriction, tapering posteriorly to subacute apex, length of process slightly more than twice the width, process extending posteriorly seven-tenths distance to level of apices of pygofer lateral lobes stout, moderately produced and rounded; in lateral aspect caudal margin evenly produced and extending most posteriorly near ventral part of margin. Anal segment as in figures 429, 474, and 524; in dorsal aspect fairly symmetrical, right side more broadly developed than left; moderately short and broad, ratio of width to length 7.8:1 in holotype, 7.1:1 in paratype; medioapical margin slightly concave; in caudal view somewhat hoodlike, with ventral profile concave.

Oliarus canyonensis, new species, is a rare member of the *O. aridus* Ball group of species but apparently is more remote from *aridus* than some of the other species of the complex. *O. canyonensis* stands well apart from other species. It is easily recognized by the uniquely serrate, truncate, dextral process and unique unequal pair of processes developing out of the basal sinistral area. Externally, the broad vertex, prominent median carina of vertex, lack of distinct macula, long rostrum, fairly short total length, and much spotted tegmina are key characters. Superficially it resembles *O. sementinus* Ball in size, broad vertex, and spotting of tegmina. From the standpoint of male genitalia, *canyonensis* possibly is closer to *O. apache* Ball, *O. papagonus* Ball, or *O. retentus* Caldwell.

Minor variation was noted in the two available specimens, and both the holotype and paratype exhibited some variation between structures on the left side compared to the right side.

The holotype male was collected at light in Deep Canyon, Riverside County, California, on August 22, 1963 (E. I. Schlinger) and obtained on loan from the collection at the University of California at Riverside. It bears an F. W. Mead Specimen No. IX-27656 label. Glue used to remount the specimen is Gelva, which is soluble in 95 percent ethyl alcohol. Additional notes and photographs of the holotype are available in the author's files. The paratype male was collected in New Mexico and bears no other data except that it formerly was in the Andreas Bolter collection and now is in the Illinois Natural History collection. An old determination label on it reads "*Cixius* sp.? Uhl" [= determination by P. R. Uhler]. Dr. H. H. Ross of the Illinois Natural History Survey has informed me that he cannot give any additional information concerning the Andreas Bolter material. Dr. Ross wrote that it was Dr. Bolter's practice to list only the state on a locality label and no notes were available to him [Ross] that would give closer approximation than the label itself.

OLIARUS HESPERIUS VAN DUZEE

Figures 5, 8, 37, 38, 179, 180
276, 315, 316, 365, 366, 422, 467, 517

Oliarus hesperius Van Duzee, 1917. Proc. Cal. Acad. Sci. 7:307-308.

Oliarus hesperius; Ball, 1934. J. Wash. Acad. Sci. 24:270 (Key).

Oliarus hesperius; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:65.

Length of male 5.4 to 6.9 mm (based on 30 specimens). Ground color of vertex and mesonotum usually fuscopiceous, somewhat variable; mesonotal carinae variable, usually orange, but sometimes individual carina or all carinae partly or completely brownish. Head: Vertex variable in shape but usually broad, with length in middle line varying from slightly greater than width at apex of posterior emargination in some specimens, to distinctly less than width in other specimens, but width usually exceeding length; median carina usually extending anteriorly approximately three-fifths length of disc. Face varying from fuscopiceous to castaneous; median carina normally orange and with broad fork at base usually weakly elevated, remainder of carina usually prominent on frons, weak to partially obsolete on postclypeus, prominent again on anteclypeus; lateral carina narrowly dull yellow or orange; maculae conspicuously ovoid; frons broad, with width distinctly greater than length in middle line. Rostrum moderately long, usually slightly surpassing posterior trochanters.

Thorax: Pronotum with intermediate carina usually narrowly separated from pale band of posterior margin. Mesonotum with carina usually equally prominent. Tegmina variably spotted, some specimens nearly immaculate, others with distinct spots at Y-vein fork, fork of Cu_1, apical crossveins, and with less conspicuous spots at other locations; apical cells of darker specimens heavily infuscated; tubercles conspicuous brownish in contrast to veins which are pale over most of tegmen except for brown veins at extreme apex of some specimens; number of apical branches of veins highly variable but most often resulting in 11 or 12 apical cells and six anteapical cells; stigma brown, length usually two to two and one-half times the width. Legs with front and middle tibiae indistinctly banded.

Male terminalia: Aedeagal complex as in figures 37 and 38; total pointed processes nine, including both branches of a forked process. Periandrium with four processes, one of which is forked; dextral process usually forked near base, outer branch much longer; left median area of ventral periandrium with two processes, the slightly lateral and basal one slender, much longer, extending sinuately to posterior part of aedeagal complex, its apex usually directed left-caudad; other ventral, left median process short, straight and slender, directed left-caudad; ventral right lateral area of periandrium with prominent, slender, straight process, primarily directed caudad, but failing to attain level of aedeagal joint; dorsal periandrium with no process. Flagellum, in ventral aspect, appearing to make complete loop; with four processes: a long, slender process on outer left margin of flagellum, a short slender, slightly curved, inner process, and two conspicuous, subequal apical processes. Styles as in figures 179 and 180; symmetrical, each shaft subterete, lateral expansion considerably preapical, slightly recurved, approximately same thickness as shaft and approximately same length as part of shaft distad of preapical lobe or expansion; inner processes weakly developed, apex very short, and slender, suggesting miniature index finger. Connective as in figure 276; moderately long and slender; combined width of ventral arms usually slightly less than width of base in posterior aspect. Pygofer as in figures 315, 316, and 366; slightly asymmetrical; medioventral process in ventral aspect usually wider than long, occasionally with length approximately equal to width, broadly pointed, usually slightly constricted at base; process extending posteriorly less than half the distance to level of apex of left pygofer lobe; left pygofer lobe extending posteriorly slightly farther than right pygofer lobe; lobes appearing stout ventrally, moderately produced and with apices subtruncate in lateral view. Anal segment as in figures 422, 467, and 517; in dorsal view slightly asymmetrical, width approximately two-thirds length, and medioapical margin straight or nearly so; in caudal view medioventral margin subtriangulate, extending ventrad as a short, acute process or spine.

Oliarus hesperius Van Duzee is a member of the O. aridus Ball group and probably the species most similar to aridus in morphology. In spite of its closeness to O. aridus, O. truncatus Van Duzee, and several other species in the aridus group, hesperius males are easily separated from males of similar species. The primary diagnostic character is the style, which is unique in that the rather slender lateral expansion is comparatively far removed from the apical area. This is the only species of Oliarus known to me in which the styles have this form. Most male specimens of hesperius have a very short and broad medioventral process of the pygofer, but in occasional specimens it is longer and somewhat similar to certain other members of the aridus group. Another distinguishing character of hesperius is the downward, spinelike, ventroapical extension of the anal segment. O. hesperius is the only member of the aridus group that has this acute process. The number, shape, and position of the processes of the aedeagal complex are other valuable key characters. The absence of a dorsal process on the periandrium, the presence of a forked dextral process, and the presence of an inner process on the loop of the flagellum will separate all other North American species from hesperius except aridus.

Van Duzee described Oliarus hesperius from a "long series" of California collected specimens, including the following material from W. M. Giffard: Los Altos, July 26, 1916; Redwood Canyon, July 2, 1916; Walnut Creek, August 10, 1916; and near Cloverdale, Sonoma County, August 3, 1916. The holotype (Number 374) is a male from Los Altos, Santa Clara County; the allotype female also is from Los Altos; they and the paratypes are in the California Academy of Sciences. I have examined three of the male paratypes labeled as such and illustrated one having the same data as the holotype. More than 10 other specimens were examined that presumably are unmarked paratypes.

Other museum specimens determined by me as Oliarus hesperius Ball were collected in the following states and counties: CALIFORNIA: Alameda, Butte, Contra Costa, Kern, Lake, Lassen, Los

Angeles, Merced, Modoc, Monterrey, Napa, Placer, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Santa Cruz, Shasta, Siskiyou, Solana, Sonoma, Stanislaus, Tehama, Yolo, and Yuba; NEVADA: Storey; OREGON: Benton, Jackson, and Wasco. Thus, the known range of hesperius Van Duzee extends from northern Oregon on the north, to western Nevada on the east, and south to near Solemint in Los Angeles County. This southernmost location is approximately 50 miles northwest of the northernmost record of O. truncatus Van Duzee in Yorba Linda, Orange County, California.

Another closely related and apparently allopatric species is Oliarus californicus Van Duzee. A distance of approximately 95 miles separates the Solamint, California record of hesperius from the closest record of californicus in Riverside County. Thus, hesperius is replaced in the southwest corner area of California by californicus and truncatus, but on the northern end of its range it is sympatric with O. aridus Ball.

Collection data on specimens of Oliarus hesperius Van Duzee include "on live oak" [Quercus sp.], "on apricot" [Prunus armeniaca Linnaeus], "swept from Arcostaphylos manzanita Parry" [Arctostaphylos parryana Lemmon], "blacklight," and "on fencepost." This fencepost and others were two miles north of Sebastopol in Sonoma County. Doctors Lois and C. W. O'Brien collected a long series of hesperius from fenceposts, noting that lichens were abundant. Possibly the adults were feeding on these lichens. At the same time of collection in summer, grasses were abundant and golden ripe in the immediate area around the fenceposts. The pasture was dry with large cracks in the soil; there were fewer Oliarus at the bottom of the slope where the plants were green.

Adult specimens of Oliarus hesperius Van Duzee have been collected from June to September.

OLIARUS ARIDUS BALL

Figures 35, 36, 39, 177, 178
275, 314, 364, 420, 421, 465, 466, 516

Oliarus aridus Ball, 1902. Can. Ent. 34:151-152.

Oliarus aridus; Van Duzee, 1914. Trans. S Diego Soc. nat. Hist. 2:36 (Comparative notes).

Oliarus aridus; Van Duzee, 1929. Pan-Pac. Ent. 6:72 (Comparative notes).

Oliarus aridus; Ball, 1934. J. Wash. Acad. Sci. 24:269-270, 272-273 (Comparative notes, key).

Oliarus aridus; Metcalf. 1936. Gen. Cat. Hemiptera Fasc. 4, part 2:52 (Eight references 1902 to 1928).

Oliarus aridus; Ball, 1938. Bull. Brooklyn ent. Soc. 32:179-180 (Comparative note).

Oliarus aridus; Osborn, 1938. Ohio biol. Surv. Bull. 6:299, 301 (Key, comparative notes, illustrations).

Oliarus aridus; Caldwell, 1938. Ohio J. Sci. 38:304 (Comparative note).

Oliarus aridus; Kramer, 1950. Ill. biol. Monogr. 20(4):10, 80-83 (Morphological notes and illustrations).

Length of male 5.9 to 8.4 mm (based on 140 specimens). Ground color of vertex and mesonotum varying from piceous to castaneous, usually fuscocastaneous; mesonotal carinae nearly concolorous in some specimens, usually a moderately contrasting dull orange or yellow-brown. Head: Vertex broad, the length in middle line equaled or exceeded by the width at apex of posterior emargination; median carina varying from absent to present for three-fourths length of disc. Face with color variable, usually castaneous; median carina usually orange, percurrent, broadly forked at base; lateral carinae pale yellow or orange, more prominent on frons than postclypeus; maculae pale yellow and large, but outline somewhat indistinct; frons broad, with width much greater than length at middle line. Rostrum moderately long, usually slightly surpassing posterior trochanters.

Thorax: Pronotum with intermediate carinae usually narrowly separated from pale band of posterior margin but occasionally tangential thereto. Mesonotum with carinae moderately conspicuous, the intermediate pair usually weaker, especially anteriorly where the carinae tend to become obsolete. Tegmina usually milky subhyaline, but occasionally vitreous; spotting present but not conspicuous; small spots usually at Y-vein fork and fork of Cu_1, and narrowly present at distal crossveins; commissure fuscous for one-third to one-half its length immediately basad of Y-vein juncture; tubercles usually moderately prominent; veins usually pale yellow basally, becoming brownish on approximately distal one-third; apical cells usually 12 and anteapical cells 6; stigma light to dark brown, usually with length two to two and one-half times the width. Legs mostly fuscous basally, yellowish distally; front and middle tibiae vaguely banded brown at each end of segment with an extensive yellowish area between.

Male terminalia: Aedeagal complex as in figures 35, 36, and 39; total pointed processes nine (including both branches of forked process). Periandrium with four processes (not counting forks); dextral process moderately long, usually directed right-caudad, straight in some specimens, distinctly and variously curved in other specimens; forked, with the minor branch introrse (to the left) and with location of fork varying from base of process to approximate midlength or slightly beyond; lateral basiventral process (sinistral) absent; mediodistal half of ventral periandrium with two moderate-sized, slender processes, the more basal one sinuately directed caudad, the more distal one straight or curving, primarily directed to the left; ventral periandrium also with a right basal process, moderately long and straight, swollen basally, slender distally; dorsal periandrium not having a process. Flagellum in ventral aspect appearing to make a complete loop; with four conspicuous processes: two long, subequal, apical processes, an inner process, and a long, slender outer process following left contour of flagellum much of its length; inner process variable from slender and acuminate to bulbous. Styles as in figures 177 and 178; moderately asymmetrical; apex of recurved portion of right style broadly truncate, but apex of left style more slender and rounded; each shaft moderately long and straight with apex expanded but not rounded, the recurvature fairly straight, and with long axis of lobe directed approximately 35 to 45 degrees laterocephalad; each inner process very short, slender, and terminating considerably laterad, near apex of recurved portion. Connective as in figure 275; moderately short and stout; combined width of ventral arms slightly less than width of base of shaft in posterior aspect. Pygofer as in figures 314 and 364; nearly symmetrical; medioventral process in ventral aspect subtriangular, constricted at base, widest subbasally, abruptly narrowed distally; slightly longer than wide; extending posteriorly slightly less than half distance to level of apex of left pygofer lobe; pygofer lobes in ventral aspect slightly diverging apically; left lobe slightly longer than the right; lobes in lateral aspect well-produced, apex truncate and with caudal margin extending most posteriorly in its ventral part. Anal segment as in figures 420, 421, 465, 466, and 516; variable, typical forms conspicuously asymmetrical in any view, certain forms on other extreme only slightly asymmetrical; in dorsal view much longer than wide, medioapical margin produced and convex; left side much more expanded than right side in typical forms, but only slightly more so in certain other forms; in lateral or caudal view subapical portion of right margin extending ventrad as a subprocess in typical forms, but other forms with little or no process; in caudal view, ventral profile concave sublaterally, convex medially, variable.

Oliarus aridus Ball provides the group name for more than one-fourth of the North American species of Oliarus. O. aridus was the first species described in this group (1902) and is the most widely distributed North American species of the genus.

Oliarus aridus Ball superficially resembles most of the other species in its group and to a lesser extent several species outside its group. Reliable diagnosis, therefore, depends upon examination of the male terminalia. Usually the peculiar shapes of the pygofer lateral lobes and the anal segment are sufficient to distinguish aridus. These structures can be seen without dissection. The caudal margin of each pygofer lateral lobe is perpendicular to the horizontal for part of its length to a truncate lobe which is produced in the extreme ventral position. This shape is peculiar to aridus. The anal segment of typical forms of aridus also is highly distinctive. The apex is extended caudoventrally and distinctively tonguelike; considerable symmetry is present, with the right margin feebly convex laterally, but produced ventrally, partly as a short process. Certain forms that I interpret as variants of aridus, exhibit only a slight amount of asymmetry in the anal segment. The typical forms inhabit at least 10 of the states in the Great Plains and Rocky Mountains and, with very slight differences, extend to several of the eastern and southeastern states. The styles of aridus are only slightly different from those in certain other species in the aridus group and require careful comparisons if used for diagnosis. The aedeagal complex with its looped flagellum, presence of inner flagellar process, forked dextral process, and lack of a process on the dorsal periandrium, separates all other species except O. hesperius Van Duzee. Although the aedeagal complex of hesperius is very close to that of aridus, the respective styles of these two species are considerably different and easily distinguished.

Variation in Oliarus aridus Ball is considerable and has already been discussed to some extent. The most noteworthy variant is a form that is usually greater in total length, has the anal segment nearly symmetrical, the inner process of the flagellum bulbous instead of acuminate, and the fork of the dextral process basal instead of at midlength. Specimens fitting this description from Herndon, Virginia, were given the manuscript name of Oliarus perspicillatus by

Van Duzee, but he never published this concept as a new species. The "Herndon Virginia form" also has been noted in Texas, Kansas, Missouri, Ohio, and Ontario, Canada. In the hundreds of male specimens which I examined, there have been a number of intergrading forms between the two extremes of "perspicillatus" on one hand, and the type material of Ball from Colorado on the other hand.

The type material of Oliarus aridus was listed by Ball as 24 specimens from Kansas, California, and various parts of Colorado. A "cotype" from Rifle, Colorado, July 25, 1900, United States National Museum and Mead Specimen Number III-16658 has been used by me to illustrate the terminalia of aridus. This specimen and the other type material of aridus in the United States National Museum have black, machine printed "TYPE" labels on them. Most of these specimens also have red U.S.N.M. cotype Number labels without actual numbers. However, each one of two other specimens of aridus in the United States National Museum has a red label with "Type No. 6279, U.S.N.M.". One of these is a male, the other a female. The label on the male specimen is as follows: "Gnd Junc Co. 7-28-00." All of this except the "28" is machine printed. Unabbreviated, this label should read "Grand Junction, Colorado, July 28, 1900." The female specimen of aridus labeled "Type No. 6279, U.S.N.M." is from "Ft. Collins Col. 8-12-01," all machine printed except the "12". Unabbreviated this label should read, "Fort Collins, Colorado, August 12, 1901". Other "cotypes" in the United States National Museum include a female and another male from Rifle, Colorado, 7-25-00; a female from Las Animas, Colorado, 7-17-01; a male and a female from

Fort Collins, Colorado, 8-12-01; a male from Sterling, Colorado, 8-3-99, and two females from Onaga, Kansas, either "5/16" or "8/16". The only other type material examined consists of a male and female from Fort Collins, Colorado, 7-17-00, each having a yellow paratype label. These "paratypes" are in the California Academy of Sciences collection. I did not discover any type material of aridus from California.

Several hundred specimens of Oliarus aridus Ball were examined from the following areas. CANADA: Ontario: Saint Catherine, Stamford, and Virgil; MEXICO: Durango: Tlahualilo; UNITED STATES: Alabama, Arkansas, Arizona, California, Colorado, Georgia, Idaho, Illinois, Indiana, Kansas, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, Ohio, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, and Wyoming. Further collecting and examination of insect collections should add several states to the known distribution of aridus. Apparently the only region of the United States without any record of aridus is the northeastern area. The only record of O. aridus in California that I can substantiate, is one from Imperial County.

Habitat and host data from the labels of specimens determined by me as Oliarus aridus Ball include the following: "in light trap"; "at light"; "Argon light trap"; "on sunflower" [Helianthus sp.]; "on peach" [Prunus persica (Linnaeus) Batsch]; "collected from Vernonia interior Small" [V. baldwini Torrey variety interior (Small)]; "tall smartweed inshore" [Polygonum sp.]; "from alfalfa" [Medicago sativa Linnaeus]; "on celery" [Apium graveolens Linnaeus, var. dulce Persoon];

"sour cherry" [Prunus cerasus Linnaeus]; "on grapefruit" [Citrus paradisi Macfadyen]; "in field"; "sweepings from weeds"; "tree trunks"; "sweepings from grass"; "hickory" [Carya sp.]; "native grass"; "grass"; "in cotton fields" and "on cotton" [Gossypium sp. probably hirsutum Linnaeus]; "in Spanish moss" [Tillandsia usneoides Linnaeus]; "Quercus virginiana" [Miller]; "in corn fields" Zea mays Linnaeus; "Forestiera acuminata" [Poret]; "on spider lilies" [Hymenocallis sp.]; "willow bark" [Salix sp.]; "on Xanthoxylum clavaherculis" [Zanthoxylum clava-herculis Linnaeus]. The hosts listed under Oliarus slossoni Van Duzee by Dozier (1928) refer to aridus Ball. These "hosts" include "on the trunks of plum trees [Prunus sp. prob. domestica Linnaeus] in an orchard" and "in sweepings made in pure stands of alfalfa"; "on pecan" [Carya illinoensis Koch].

Oliarus aridus Ball has been collected in all months from March to November, with most collections occurring May to September.

<u>OLIARUS</u> <u>TRUNCATUS</u> VAN DUZEE

Figures 58, 59, 200, 201, 286, 326, 380, 431, 476, 526

<u>Oliarus truncatus</u> Van Duzee, 1929. Pan-Pac. Ent. 6:72.

<u>Oliarus truncatus</u>; Ball, 1934. J. Wash. Acad. Sci. 24:270 (Key)

<u>Oliarus truncatus</u>; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:106 (Listed).

Length of male 5.1 to 7.2 mm (based on 11 specimens). Ground color of vertex and mesonotum fuscous; mesonotal carinae usually dull orange, sometimes fuscous, varying among specimens and among carinae of a single specimen, intermediate carinae tending to be lightest, lateral carinae darkest. Head: Vertex moderately broad, length slightly greater than width at apex of posterior margin, sides of vertex subparallel. Face in most specimens mostly castaneous but usually with some fuscous, particularly on frons-postclypeus border area; median carina prominent, distinctly forked at base, percurrent through anteclypeus, usually orange-colored for all or most of length; lateral carinae moderately prominent, yellowish to dull orange-brown, slightly less prominent on postclypeus; maculae varying from moderately conspicuous to absent, usually weak; frons broad, width considerably greater than length in middle line. Rostrum long, usually surpassing caudal margin of posterior trochanters by at least half the length of its apical segment.

Thorax: Pronotum with intermediate carinae usually narrowly separated from pale band of posterior margin. Mesonotum with carinae of nearly equal prominence. Tegmina usually with brownish areas at apical crossveins and some apical cells, but other specimens (usually from Baja California, Mexico) tending to be immaculate or nearly so; commissure usually weakly embrowned basad of Y-vein juncture; tubercles concolorous, not prominent; veins yellowish to light brown basally, fuscous apically; number of branches of veins at apex of tegmina quite variable, Sc usually with two branches, R usually with three branches, M with four or five branches, rarely three, Cu_1 usually with two branches, sometimes three; apical cells 11 or 12 and anteapical cells 6; stigma brown, conspicuous, length usually two and one-half to two and three-quarters times the width; legs mostly brownish without distinct banded pattern.

Male terminalia: Aedeagal complex as in figures 58 and 59; total pointed processes usually 9, sometimes 10. Periandrium usually with four, sometimes five processes; without basal dextral process or other right-lateral process; sinistral process short, straight, slender, and acute; median basiventral area with a short, nearly straight acute process, stout basally, slender distally and sometimes with a very small slender process a very short distance caudad from this median basiventral process; left ventroapical area with prominent process directed left-caudad initially, then curving approximately 90 degrees to a left-cephalad direction, becoming nearly straight distal half, gradually rotating or twisting throughout length; dorsal periandrium with a conspicuous, apical, slender, acute process that curves primarily right-ventrocaudad. Flagellum appearing to make a complete loop in ventral view; with five processes; ventrobasally with a very slender small process that appears attached to the apex of the periandrium, but which remains with the flagellum when the flagellum is extended to the mating position; outer prebasal area giving rise to a long, gently curving process directed cephalad adjacent to the dorsal surface of the flagellum; inner process moderately long, acute, slender, and smoothly curving right-cephalad; apex of flagellum with two subequal, moderately long and stout processes, with apex of outer process appearing slightly more acute than apex of inner member of pair. Styles as in figures 200 and 201; symmetrical or nearly so; *in situ*, styles contiguous ventrodistally, each style expanded and angulately recurved apically, truncately rounded at apex of recurved portion; inner processes moderately long and fingerlike, not extending beyond recurved portion of style. Connective as in figure 286; long and slender, combined width of ventral arms slightly greater than width of base in posterior aspect. Pygofer as in figures 326 and 380, symmetrical or nearly so; medioventral process in ventral view with width approximately three-fourths length, widest subbasally, abruptly tapering distally to a semiacute apex; process extending posteriorly nearly half the distance to level of apices of the pygofer lateral lobes; lateral lobes stout in ventral view, moderately produced and rounded in lateral view. Anal segment as in figures 431, 476, and 526; in dorsal view symmetrical, broadest at midlength, width approximately four-fifths length; medioapical margin slightly concave; ventral profile in caudal view straight except for short ventral curve at each lateral margin.

Oliarus truncatus Van Duzee is an uncommon member of the *O. aridus* Ball group. The only other species in this group with five flagellar processes instead of four or less is O. sementinus Ball, but it differs from O. truncatus in several characteristics, including a single forked process on the basiventral area of the periandrium, as opposed to the two or three small unforked processes of truncatus. The shape and location of these two short processes are unique for truncatus among all the species of Oliarus I have seen. Other unique structures in truncatus include the prominent, slightly twisting, left apical process of the ventral periandrium and the apical process of the dorsal periandrium. It is the only species of the aridus group with this process directed left-caudoventrally. Another structure which is peculiar to truncatus in location and shape is the basiventral process of the flagellum. The lack of any processes along the right lateral margin of the periandrium is distinctive. Externally, truncatus can be separated from closely related species by its broader tegminal costal cell which is one-half wider than the adjacent outer discal cell in truncatus but approximately the same width as this discal cell in other similar species.

Variation, within limits, is common in Oliarus truncatus Van Duzee. Specimens in Lower California, Mexico, average greater in total length than those of Southern California, United States; the Mexican specimens tend to have the veins of the tegmina with more branches reaching the apex, and to have the tegmina more immaculate; the United States forms tend to have more conspicuous infuscations around the apical crossveins and some spotting in the apical cells. No Mexican specimens were seen with apical spotting.

The holotype male of Oliarus truncatus Van Duzee was collected by E. P. Van Duzee, July 4, 1913, at Alpine, San Diego County, California. It is in the collection of the California Academy of Sciences at San Francisco, according to 1964 correspondence with Dr. P. H. Arnaud, Jr., Associate Curator. I have examined what I believe to be the six male paratypes referred to by Van Duzee in the original description. Three males with San Diego County, California, labels (E. P. Van Duzee) have the inked date "7-27-13." The original description gives "January 27, 1913" as the collecting date and La Jolla [San Diego County], California, as the locality for these three paratypes. I believe "January" may be incorrect, as nearly all other specimens available have been collected in summer. Aside from this possible mistake, the original description seems accurate. The other three paratypes were collected by Mr. W. S. Wright at San Diego, California, August 21, 1913.

Other species examined were limited to San Diego County, California, in the United States and several localities (including the southern tip area) in Baja California, Mexico. No habitat information has been located on any of the available specimens.

The collecting dates for the San Diego County specimens range from July 4 to August 21; the range of collecting dates for the Baja California, Mexico, specimens is from April to July 29.

OLIARUS SEMENTINUS BALL

Figures 52, 53, 192, 193, 283, 322, 376, 428, 473, 523

Oliarus sementinus Ball, 1902. Can. Ent. 34:152-153.

Oliarus sementinus; Ball, 1934. J. Wash. Acad. Sci. 24:270 (Key); 274 (Compared with *Oliarus littoralis* Ball); 276 (Comparative notes).

Oliarus sementinus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:100-101 (Five references 1902 to 1917).

Length of male 4.0 to 5.4 mm (based on 15 specimens). Ground color of vertex and mesonotum varying from testaceous and ferrugineous to fuscous; mesonotal carinae usually testaceous. Head: Vertex usually wider than long in type series and certain other specimens, varying to slightly longer than wide in other specimens, with ratio of length in middle line to width at apex of posterior emargination varying (1:0.87-1.25); median carinae present and traversing most of disc, more elevated in some specimens than in others. Face usually testaceous or castaneous, frons smooth and polished, postclypeus lightly rugose and polished; median carina indistinct or wanting; lateral carinae feebly elevated but with broad, pale yellow border, widening at epistomal suture, much narrowed and somewhat indistinct along postclypeus; maculae conspicuous; frons unusually broad and convex, width approximately twice the length in middle line. Rostrum moderately long, usually slightly surpassing posterior trochanters.

Thorax: Pronotum with intermediate carinae usually tangential to pale border of posterior margin. Mesonotum with carinae equally prominent. Tegmina nearly immaculate in some specimens, in other specimens narrowly spotted along apical crossveins and in membrance of some apical cells; clavus occasionally with small brown spot at Y-vein fork, commissure varying to immaculate to lightly embrowned short distance basad of Y-vein juncture; tubercles of moderate size, concolorous with the veins which tend to be a lighter shade of brown basally than apically, except costa which is pale entire length; stigma usually pale yellow, sometimes testaceous, subtriangular, its length usually two and one-half to three times width. Legs pale yellow to light brown without banded pattern.

Male terminalia: Aedeagal complex as in figures 52 and 53; total pointed processes nine, including both branches of a forked process. Periandrium with three processes, one of which is forked; dextral process in a ventral, right-mediobasal position (an atypical position in _O. aridus_ group), forked, with left branch one-half to two-thirds length of right branch; sinistral process absent; ventral subapical area with long, slender process extending caudad initially, then curving left and left-cephalad; dorsal periandrium with moderate-sized, retrorse, subapical process. Flagellum appearing to make complete loop from ventral aspect; with five processes; outer, basal portion of flagellum with short, very slender process; outer, left dorsal part of flagellum with very long, fairly straight slender process; inner part of loop with moderately small, gently curved, acute process; apex of flagellum with pair of subequal, moderately long and slender process. Styles as in figures 192 and 193; almost symmetrical; fairly long, apically expanded and recurved; inner processes subequal, moderately long, slender, and curved. Connective as in figure 283; moderately long and slender; combined width of ventral arms approximately equal to width of base in posterior aspect. Pygofer as in figures 322 and 376; approximately symmetrical; medioventral process in ventral aspect a little longer than wide, broadest subbasally, abruptly narrowed to acute apex; process extending posteriorly slightly less than half the distance to level of apices of pygofer lobes; lateral lobes rather stout in ventral aspect and well produced; lobes in lateral view obliquely subtruncate. Anal segment as in figures 428, 473, and 523; in dorsal view distinctly longer than wide, nearly symmetrical; medioapical margin truncate to slightly concave; in caudal view with median portion of ventral profile distinctly concave.

Oliarus sementinus Ball is the only member of the *O. aridus* Ball group having a short, slender, acute process at the outer base of the flagellum, but *O. truncatus* Van Duzee has a fairly similar process at the ventral inner base. Also, the lack of a sinistral process is diagnostic, as well as a general reduction in number of periandrial processes. The "short head" mentioned by Ball (1902) is helpful but not definitive.

The principal variant encountered is the darkest and largest specimen examined. It was collected at the Laguna Mountains, California, July 27, 1940, by D. J. and J. N. Knull. It is the only specimen from California I have seen. The ground color of the vertex, mesonotum, and face is fuscous; the costa and stigma are brownish; the tubercles are prominent, being brown in contrast to pale veins over most of the basal two-thirds of the tegmina; its genital characters conform to a syntype.

Oliarus sementinus Ball was described by Ball "from seventeen specimens from Las Animas, Colo." [Colorado]. I have located and examined three males and three females of this series in the United States National Museum. Each syntype examined was accompanied by three machine printed labels. Each top label is white paper and printed "L. Animas Col. 7-17-01" on two lines; the second label is white paper and printed "TYPE"; the third label is red paper with blank space in the middle, but at the top is printed "Cotype No." and at the bottom "U.S.N.M." One of the males is hereby selected as lectotype and has been marked with a lectotype label and an F. W. Mead Specimen No. I-23657 label. This specimen was used to illustrate sementinus in this revision, except the dorsal view of the anal segment is of a different male in the type series.

Other male specimens determined as Oliarus sementinus Ball were collected in ARIZONA: Flagstaff, Holbrook, St. Johns, and Willcox; NEW MEXICO: Elkins; UTAH: Cisco, Thompsons. Thus, the known range of Oliarus sementinus is confined to five states in the southwestern part of the United States.

No specific habitat or host information on Oliarus sementinus Ball is available. The known seasonal distribution extends from late June or early July to late August.

OLIARUS PIMA KIRKALDY

Figures 42, 43, 184, 185, 279, 318, 368, 369, 424, 469, 519

Oliarus pima Kirkaldy, 1907. Bull. Hawaiian Sug. Plrs' Ass. Exp. Stn 4:62-63.

Oliarus nogalanus Ball, 1934. J. Wash. Acad Sci. 24:270 (Key); 272-273 (Systematic notes)

Oliarus pima; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2: 95 (Four references 1907 to 1917).

Oliarus pima; Ball, 1938. Bull. Brooklyn ent. Soc. 32:180 (Systematic notes; Oliarus nogalanus Ball synonymized under Oliarus pima Kirkaldy.

Oliarus pima; Caldwell, 1938. Ohio J. Sci. 38:304-305 (Systematic notes).

Length of male 6.0 to 7.5 mm (based on 125 specimens); lectotype 7.0 mm. Ground color of vertex and mesonotum varying from piceous to castaneous, usually fuscous; numerous specimens having lateral portion of mesonotum fuscous, disc of mesonotum castaneous or nearly so; mesonotal carinae usually orange, becoming somewhat brownish or yellowish in a few atypical specimens. Head: Vertex moderately broad, length in middle line varying from slightly more than to slightly less than width at apex of posterior emargination; slightly diverging basally; median carina usually traversing basal half of disc. Face with color somewhat variable but usually castaneous; median carina with basal fork of comparatively large size but delimited by triangularly shaped darkly pigmented area, bordering carinae of triangular area obsolete or nearly so; median carina usually orange, moderately elevated, and traversing length of face distally from basal fork; lateral carinae narrowly orange, somewhat indistinct throughout length on frons and postclypeus: maculae conspicuous pale yellow, usually elliptical or oblong, outline somewhat indistinct in some specimens; frons broad, with width conspicuously greater than length in middle line (67:38 in lectotype). Rostrum moderately long, normally with apex slightly surpassing posterior trochanters.

Thorax: Pronotum with intermediate carinae normally narrowly separated from pale band of posterior margin, occasionally tangential. Mesonotum with moderately conspicuous carinae, usually subequal in prominence except usually feebly elevated anterior portion of intermediate pair. Tegmina variable, but spotting usually pronounced on clavus and corium in contrast to translucent cell membranes; spots normally present at fork of Y-vein, fork of Cu_1, distal crossveins, and some of the apical cells; some specimens with claval area considerably fuscous, especially along commissure; commissure normally narrowly darkened basad of Y-vein juncture; tubercles moderate in size, comparatively inconspicuous; veins uniformly brown; apical cells normally 12 and anteapical cells 6; stigma brown and moderately narrow, with length approximately three times greater than width. Legs mostly brownish, becoming testaceous distally in numerous specimens.

Male terminalia: Aedeagal complex as in figures 42 and 43; total pointed processes eight (not including forks). Periandrium with four processes, one of which is forked; dextral process not inserted in strict lateral position but in a more right-medioventral position, relatively short, forked, with fork occurring at midlength, shorter branch of fork directed ventrad primarily, main branch curving right-laterad; sinistral process a slender, tortuous process, curving three-dimensionally throughout its length, with successive directions being primarily left-caudad, right-caudad, ventrad, and left-ventrocephalad; apicoventral area of periandrium with a conspicuous, somewhat falcate process, directed primarily to the left; dorsal periandrium with left apical area giving rise to a conspicuous, laterally compressed process, directed dorsally primarily and somewhat to the right, with distal third slightly swollen and apex rounded. Flagellum in ventral aspect appearing to make a complete loop, straight in basal part of loop; with four processes, including two conspicuous subequal, long, apical processes; a long slender outer process inserted prebasally, with distal portion adjacent to dorsal surface of flagellum (hidden in ventral view); inner portion of flagellar loop with a short, stout process having apex directed left-ventrad. Styles as in figures 184 and 185; moderately asymmetrical, apices expanded and recurved; left style with posterior margin uniformly recurved, but right style with posterior margin extended at right angles for most of its width before recurving right-cephalad into rounded apical portion; inner processes slender, moderately short, left process slightly broader than right process and not extending as far posteriorly as the right. Connective as in figure 279; comparatively short and stout; combined width of ventral arms slightly less than width of base of shaft in posterior aspect. Pygofer as in figures 318, 368, and 369; nearly symmetrical; medioventral process in ventral aspect distinctly longer than wide, constricted at base, widest subbasally, abruptly narrowed distally, apex acute; process extending posteriorly slightly less than half the distance to level of apex of left pygofer lobe; pygofer lobes thick, with left lobe slightly longer than right lobe; in lateral aspect lobes with posterior margin most produced near ventral part of length; left lobe usually with very slight concavity at apex, right lobe truncate. Anal segment as in figures 424, 469, and 519; in dorsal view slightly asymmetrical, primarily in apical area; moderately broad, width approximately two-thirds the length; medioapical margin convex, in caudal aspect ventral profile nearly straight, slightly concave at midlength.

Oliarus pima Kirkaldy is a common species in the *O. aridus* Ball group, but in contrast to the wide distribution of *aridus*, it is confined to the southwestern United States. *O. pima* can be separated from other species by the shape of the inner flagellar process, which is short, stout, and curved left-ventrad. Another excellent diagnostic character is the straight basal half the flagellum as contrasted to the rounded basal halves in other species of the *aridus* group. *O. pima* is one of three species in the *aridus* group to have a combination of four processes on the periandrium (counting the forked dextral process as one process). The other two species with this combination are *O. aridus* and *O. hesperius* Van Duzee. Numerous differences exist between these three species; examination of the shapes of the respective styles is sufficient for differentiation;

also, O. pima is the only one with the periandrium having a single, stout, left-curving, medioapical ventral process; additional differences are evident in the respective pygofers and anal segments (see figures).

The original description ignored a listing of the specimens in the type series. The type series apparently all came from Nogales, Arizona, and was collected by Koebele (no. 2518) in September. Ball (1938) wrote that he had examined the type series of O. pima Kirkaldy in the California Academy of Sciences collection and that this series was mixed. I interpret Ball's remarks (1938) as saying that the minor part of this original type series of pima is Oliarus sonoitus Ball and that the major part of the original series is the same as Oliarus nogalanus Ball which he therefore was synonymizing under O. pima because of the law of priority. Ball, like Kirkaldy, did not mention specific information about types.

When I wrote to the California Academy of Sciences for a loan of the type material of O. pima Kirkaldy, Dr. Paul Arnaud could not find the pima types, but he sent all specimens from the line collection. I believe that I have discovered the major portion of the original type series of pima unmarked in this borrowed material. This consists of 10 females and 1 conspecific male having identical label data of "Nogales, Ariz., 1-IX-06, A. Koebele, Collector, Koebele Collection." I dissected the male and labeled it "F. W. Mead Specimen No. IV-6651." This specimen was used to illustrate this paper, and I hereby propose it as lectotype and have placed a lectotype label on it.

The distribution of Oliarus pima Kirkaldy, as determined from male specimens at my disposal, is as follows. ARIZONA: Counties of Cochise, Coconino, Graham, Maricopa, Mohave, Pima, Santa Cruz, and Yavapai; CALIFORNIA: Escondido, San Diego County; NEW MEXICO: Sierra County, UTAH: Washington County. The only "host" information on any of the specimens is "Chrysothamnus speciosus" [Nuttall = C. nauseous (Pall.) Britton, subsp. albicaulis (Nutt.) Hall and Clement], this label on a specimen collected at Leeds, Utah, 20-VII-1931 (E. W. Davis). An "at light" label was on a specimen from Portal, Cochise County, Arizona, 27-VI-1963 (A. Raske).

The available specimens were collected in the months of June, July, August and September.

OLIARUS SONOITUS BALL

Figures 3, 44, 45, 186, 187, 280, 370, 371, 425, 470, 520

Oliarus pima Kirkaldy, Ball, 1934. J. Wash. Acad. Sci. 24:268, 270 (Misdetermination, *fide* Ball 1938).

Oliarus sonoitus Ball, 1938. Bull. Brooklyn ent. Soc. 32:179-180 (Equals *pima*; Ball, 1934).

Oliarus nigravittus Caldwell, 1938. Ohio J. Sci. 38:304-305. New synonymy.

Length of male 6.6 to 8.5 mm (based on 70 specimens); allotype 7.4 mm. Ground color of vertex and mesonotum piceous to castaneous, lateral areas of mesonotum consistently piceous, disc of mesonotum and vertex highly variable; mesonotal carinae orange or brownish yellow, with color in some specimens spreading onto adjacent areas of disc. Head: Vertex broad, variable, with length in middle line usually less than width at apex of posterior emargination (length to width 1.08:1 to 1:1.43); median carina conspicuous on basal half of disc. Face usually castaneous but in some specimens fuscous to piceous, frons commonly partly or entirely darker than clypeus; median carina with basal fork represented by triangular piceous area bordered by very feeble or obsolete basal fork varying from pale yellow to piceous, distally orange (usually) and percurrent distally from indication of basal fork; lateral carinae narrowly orange, occasionally varying to pale yellow and light brown; maculae oblong, pale yellow and conspicuous; frons broad, its width approximately twice as great as length in middle line. Rostrum long, usually slightly exceeding posterior trochanters; apex of rostrum in an occasional specimen almost or completely attaining caudal margin of posterior trochanters, in still other specimens exceeding trochanters by as much as half length of its apical segment.

Thorax: Pronotum with intermediate carinae usually narrowly separated from pale band of posterior margin. Mesonotum with carinae in most specimens uniformly conspicuous. Tegmina varying from nearly immaculate to conspicuously spotted, usually inconspicuously spotted; typical specimens with small spot at fork of Y-vein, tiny spot at fork of Cu_1, narrow infuscations around apical crossveins, and with commissure narrowly brown basad of Y-vein juncture; tubercles inconspicuous, concolorous with veins which usually are light brown on most of basal two-thirds of tegmen, fuscous on distal third; apical cells normally 12 and anteapical cells 6; stigma brown, moderately narrow, usually with length three times greater than width; legs mostly fuscous basally, light brown to dingy yellow distally; front and middle tibiae indistinctly banded, each tibia narrowly fuscous at each end and with broad light brown band between.

Male terminalia: Aedeagal complex as in figures 44 and 45; total pointed processes nine, not including forks. Periandrium with five processes; dextral process moderately long, directed right-caudad, forked near the apex; sinistral margin uninterrupted from base to near apex where a moderate-sized process is directed ventrally primarily; medioapical area of ventral periandrium giving rise to a conspicuous process, somewhat swollen basally, uniform in width for most of length and directed left-caudad primarily; left basiventral area of periandrium with a fairly small process that usually extends caudad, curves 90 degrees to the right, then ventrocephalad; dorsal periandrium with a moderate-sized apical process that is slender, straight, acuminate, and directed primarily right-cephalad in dorsal view. Flagellum in ventral aspect appearing to make a complete loop; with four processes; apically with two subequal, long, rather stout processes; area near outer left margin of flagellar loop with a long, slender process usually curving to and lying near the dorsal surface of the flagellum and concealed in ventral view except at basal portion; inner margin of loop of flagellum with a comparatively long, very slender process directed left-cephalad after curving 90 degrees away from direction of flagellum. Styles as in figures 186 and 187; slightly asymmetrical; shaft moderately long and slender, unevenly rounded and expanded apically, with apices of recurved portions subtruncate; inner processes moderately long and slender, slightly curved, apex of left process terminating abruptly. Connective as in figure 280, moderately long and stout; combined width of ventral arms approximately equal to width of base in posterior aspect. Pygofer as in figures 319, 370, and 371; asymmetrical; medioventral process in ventral aspect longer than wide (11:8 in allotype), constricted at base, widest subbasally, apex acute, extending posteriorly less than half the distance to level of apex of left pygofer lobe; pygofer lateral lobes in ventral aspect with left lobe distinctly longer; right lobe in lateral aspect moderately produced with posterior margin unevenly convex; left lobe with a distinctive notch and a short thumblike lobe in addition to a usually smoothly rounded apex, the thumblike lobe arising above the midlength of the posterior margin, the broader convexity near midlength of the posterior margin. Anal segment as in figures 425, 470, and 520; asymmetrical, with left caudolateral angle more produced than right caudolateral angle; longer than wide (width three-fourths the length in allotype), caudal margin irregularly and slightly convex; in caudal view ventral margin conspicuously concave, laterally extending slightly more to right than to left.

Oliarus sonoitus Ball, a member of the O. aridus Ball group, is closest to O. aridus and O. pima Kirkaldy in size, external appearance, and male terminalia. O. sonoitus usually has more black areas around the front of the head than do aridus or pima, and a dextral process forked near the apex, not at midlength or more basad as in aridus, pima, or other species of the group. O. sonoitus has five periandrial processes instead of four as in aridus and pima. O. sonoitus differs from other species of Oliarus in the shape of the anal segment which is both widest subcaudally and with the left caudolateral angle more produced than the right caudolateral angle. Perhaps the most distinctive characters in sonoitus are the short thumblike lobe of the posterior margin of the left lateral lobe of the pygofer slightly above the midlength of its caudal margin, the notch below this small lobe, and the similar broadly rounded apex of the right pygofer lobe which has no thumblike lobe above it.

The variation observed in O. sonoitus Ball was minor except that the dextral process of one specimen was not forked.

Ball described Oliarus sonoitus from a female holotype, male allotype, and 14 paratypes collected by W. W. Jones at Douglas, Cochise County, Arizona, July 12, 1932. These specimens were found without type labels in the line collection of the United States National Museum. A male and female on the same pin with two small rectangular pieces of plain red paper are what I interpret to be the holotype and allotype. The allotype male was given F. W. Mead Specimen Number III-166516 and used to illustrate sonoitus in this work.

Other specimens were examined from MEXICO: Chihuahua, 116 miles north of Chihuahua; Tamaulipas, 25 miles south of Ciudad Victoria; UNITED STATES: Arizona: Counties of Apache, Cochise, Graham, Pima, and Yavapai; California: Newberry Springs [San Bernardino County?]; New Mexico: Counties of Chaves, Eddy, and Lincoln; Texas: Counties of Brewster, Jeff Davis, Pecos, Uvalde, and Webb. Thus, the known range of Oliarus sonoitus Ball is in the southwestern United States and northern Mexico.

I have examined in the Ohio State University collection the holotype male and only paratype (a male) of Oliarus nigravittus Caldwell [from Uvalde, Texas]. They are conspecific with Oliarus sonoitus Ball. Both of these species descriptions were published in 1938, but Ball's name has priority; therefore, Oliarus nigravittus Caldwell is listed as a junior synonym above.

Three specimens of Oliarus sonoitus Ball were taken at light in Portal, Arizona; a specimen from Mexico was collected in grassland; a specimen from Roswell, New Mexico, was collected on Gutierrezia longifolia [Greene].

Oliarus sonoitus Ball has been collected during the months of May, June, July, August; September, and November.

OLIARUS KIEFERI, NEW SPECIES

Figures 6, 40, 41, 181, 182, 183, 277, 278, 317, 367, 423, 468, 518

Length of male 4.2 to 5.3 mm (based on 36 specimens); holotype 4.8 mm. Ground color of vertex and mesonotum fuscous; mesonotal carinae nearly concolorous in holotype, usually orange in other specimens, with color sometimes spreading onto disc between carinae. Head: Vertex broad, variable; ratio of length in middle line to width at apex of posterior emargination (1:1 to 1:1.25), holotype (1:1.04); median carina conspicuous, extending anteriorly one-half to two-thirds length of disc. Face castaneous to fuscocastaneous; median carina conspicuously elevated and testaceous or ochraceous on frons, variable on postclypeus with elevation and color obsolete or nearly so near midlength in some specimens, but in other specimens with elevation and color only slightly less prominent; median carina percurrent and narrowly yellowish on anteclypeus but outline of basal fork on frons feeble or obsolete; lateral carinae moderately elevated and narrowly yellowish; maculae pale yellow, conspicuous; frons unusually broad, with width approximately twice the length in middle line (ratio in holotype 49:25). Rostrum moderately long, usually slightly surpassing posterior trochanters, sometimes conspicuously so.

Thorax: Pronotum with intermediate carinae narrowly separated from pale band of posterior margin, occasionally tangential. Mesonotum with carinae uniform, and moderately conspicuous. Tegmina milky subhyaline and usually with several moderately conspicuous brown spots (some specimens nearly immaculate); size and number of spots variable but usually present at fork of Y-vein, fork of Cu_1, crossveins r-m and m-cu, and all apical crossveins; some apical cells and occasionally one or two discal cells with irregular, small, smoky brown areas; commissure usually fuscous basad of Y-vein juncture for approximately one-half the distance to posterior apex of mesonotum; tubercles moderately conspicuous, contrasting somewhat with veins which primarily are testaceous on basal three-fourths of tegmen and fuscous on distal one-fourth; apical branching of tegminal veins subject to considerable variation, but majority of specimens having 11 apical cells and 6 anteapical cells (holotype with number of branches at apex of left tegmen as follows: Sc one, R three, M five, and Cu_1 two); stigma variable, usually light brown, but testaceous or whitish in some specimens, and with length approximately three times greater than width. Legs fuscous basally and pale yellow distally; front and middle tibiae indistinctly banded, with each tibia dingy yellowish in middle portion and brownish basally and apically.

Male genitalia: Aedeagal complex as in figures 6, 40, and 41; total pointed processes nine, not counting forks. Periandrium with five processes, not counting forks; dextral process moderate in length, fork occurring slightly distad from midlength of process; sinistral process prebasal, moderately short, directed left-caudad most of length, apex curving caudad, length approximately one-half the length of the dextral process; median area of ventral periandrium with short, slender, straight process directed caudad primarily and slightly to the right; midlength of right lateral area of ventral periandrium with moderately long, straight process directed caudad primarily and somewhat to the right; dorsal periandrium with apical retrorse process directed right-anterodorsad, apex rounded. Flagellum in ventral view appearing to make a complete loop; with four processes; apically with two long, subequal, moderately slender processes; inner portion of flagellar loop with a straight, slender, acute process; outer portion of loop with a long, slender process arising prebasally and somewhat following contour of loop, but apex of process curving slightly to left, counter to direction of loop. Styles as in figures 181, 182, and 183; symmetrical or nearly so; each shaft moderately long and slender, expanded and recurved apically; inner processes moderately long, very slender, slightly curved, arising in distal third of each style. Connective as in figures 277 and 278; moderately long and slender; combined width of ventral arms equal to width of base of shaft in posterior aspect. Pygofer as in figures 317 and 367; symmetrical or nearly so; medioventral process in ventral aspect short, with width equal to length in most specimens, subtriangular, slightly constricted at base, broadest near base, apex slightly rounded; process extending posteriorly approximately one-third the distance to level of apices of pygofer lateral lobes; lateral lobes greatly produced; in lateral aspect with semi-rounded apex unevenly produced and occurring slightly below midlength of posterior margin; ventral portion of posterior margin scalloped. Anal segment as in figures 423, 468, and 518; symmetrical or nearly so; in dorsal view long and moderately slender, width approximately three-fifths the length; medioapical margin broadly concave resulting in a pair of posterolateral convexities; in caudal aspect slightly asymmetrical; median portion of ventral profile deeply and subrectangularly concave.

Oliarus kieferi, new species, is a member of the *O. aridus* Ball group. Previously it has been misidentified most often as *O. californicus* Van Duzee and to a lesser extent as *O. pima* Kirkaldy. It also is closely related to *O. knulli*, new species. The anal segment of *kieferi* is sufficiently distinctive to separate it from other North American species by this structure alone (see figures); in dorsal aspect it is long and fairly slender, the lateral margins are slightly convex and are more nearly parallel than in other North American species; the posterior margin is more broadly concave than in *californicus*. The anal segment of *kieferi* is most distinctive when viewed caudally; especially noteworthy is the subrectangular notch or concavity along the medioventral profile which is peculiar to this species; also the profile does not have the evenly tectiform appearance of the other species with which it might be confused.

Only two other species in the *Oliarus aridus* group have the combination of five periandrial and four flagellar processes (not counting subprocesses produced from forks). These are *californicus* Van Duzee and *sonoitus* Ball. Among other differences, the latter is at least 0.5 mm larger than *O. kieferi*, new species, and lacks the right-lateroventral process arising slightly caudad of the dextral process of the periandrium in *kieferi*. *O. californicus* has the inner process of each style arising at the middle of the style whereas in *kieferi* it arises in the distal third of the style; the apical area of the ventral periandrium of *californicus* has a conspicuous left-curving process; *O. kieferi* has no process of this description (see figures). In external appearance *kieferi* is very similar to *knulli*, but the latter does not have the process on the inner margin of the flagellar loop of the aedeagal complex present in *kieferi*.

Oliarus kieferi, new species, is described from the holotype male, allotype female, and 92 paratypes. The holotype and allotype are from Yarnell Heights [Yavapai County], Arizona, June 20, 1935 (E. D. Ball) United States National Museum collection. A male paratype and a female paratype are on the same paper point as the holotype and allotype, making a total of four specimens on the same point. The holotype is glued to the apex of the point, the allotype is next to the pin. The label, "F. W. Mead Specimen No. II-15644" affixed to the pin refers to the holotype. The male terminalia of the holotype are illustrated in this work.

Paratypes consist of the following specimens, all from Coconino and Yavapai Counties, Arizona: Ashfork (E. D. Ball): 7-13-29, one male, one female; 7-14-29 one male, one female; 7-15-29, four males, five females; 7-18-29, one male, two females; 8-16-29, two males, two females, United States National Museum; Ashfork, June 30, 1933 (P. W. Oman) United States National Museum collection; Prescott National Forest, VI-20-37 (D. J. and J. N. Knull), one female, United States National Museum, and one female, Ohio State University collection; Prescott, VI-8-41 (D. J. and J. N. Knull) one female, Ohio State University collection; Prescott, 7-12-1947 (R. H. Beamer) one male, University of Kansas collection; Seligman, 7-29-36 (D. R. Lindsay) three females, University of Kansas collection; Williams, 7-13-29 (E. D. Ball) eight males, three females, United States National Museum collection; Williams, VII-2-39 (D. J. and J. N. Knull), three males, six females, Ohio State University collection; Yarnell Heights (E. D. Ball); 7-21-29, five males, five females; 8-20-29, one male, two females; 6-20-35, six males, seven females; 6-21-35, two males, five females; 8-27-35, three males, four females, all in United States National Museum collection; Yarnell Heights (P. W. Oman) 6-29-33, one female, United States National Museum collection; Coconino County, 8-13-1927, (L. D. Anderson) one male, University of Kansas collection.

I also identified as Oliarus kieferi, new species, a slightly damaged female from Chad's Utah, 7-23-08, United States National Museum collection.

No host or habitat data are available concerning Oliarus kieferi, new species. The known seasonal distribution is in June, July, and August.

I take great pleasure in naming this species in honor of the late Arthur S. Kiefer, former Chairman of the Science Department, North High School, Columbus, Ohio. Mr. Kiefer was an unusually fine gentleman whose example and encouragement led many young people into careers in biology and other phases of science.

OLIARUS CALIFORNICUS VAN DUZEE

Figures 46, 47, 48, 188, 189, 281, 320, 372, 373, 426, 471, 521

Oliarus californicus Van Duzee, 1914. Trans. S Diego Soc. nat. Hist. 2:36-37.

Oliarus californicus; Van Duzee, 1929. Pan-Pac. Ent. 6:72 (Comparative notes).

Oliarus californicus; Ball, 1934. J. Wash. Acad. Sci. 24:270 (Key).

Oliarus californicus; Metcalf, 1936. Gen. Cat. Hemiptera Fasc. IV, part 2:55 (Three references listed 1914-1917).

Length of male 5.0 to 5.6 mm (based on 25 specimens). Ground color of vertex and mesonotum fuscous; mesonotal carinae usually orange, variable in intensity; color extending into adjacent areas of disc in some specimens. Head: Vertex moderately broad, varying from slightly longer to slightly shorter in middle line than wide at apex of posterior emargination; median carina extending anteriorly approximately three-fifths length of disc. Face usually fuscous, varying to castaneous in some specimens; median carina percurrent, orange or yellowish, forking at base to form a prominent triangle; lateral carinae narrowly pale orange or yellow; frons broad, width much greater than length in middle line (1.7 to 2.3:1). Rostrum moderately long, usually slightly surpassing posterior trochanters but in some specimens only attaining or not quite attaining caudal margin.

Thorax: Pronotum with intermediate carina narrowly separated from pale band of posterior margin. Mesonotum with carinae of nearly equal prominence. Tegmina lightly to moderately spotted, size of spots somewhat variable; spots usually present at fork of Y-veins, fork of Cu_1, apical crossveins, and occasionally in some of the apical cells; tubercles brownish and moderately prominent, contrasting with pale veins except where veins become brown at apex; an occasional specimen with R brown for a short distance distad from juncture with Sc; commissure fuscous for most or all of its length basad from Y-vein juncture; apical cells usually 12 and anteapical cells usually 6; stigma brownish, length approximately three times greater than width. Legs brown basally, pale distally, not banded.

Male terminalia: Aedeagal complex as in figures 46, 47, and 48; total pointed processes nine, not including any forks. Periandrium with five processes; dextral process moderately long, slender, slightly curved, not forked; left side not having a basiventral (sinistral) process but subapically with a curved prominent process which is primarily directed ventrad in typical specimens (San Diego area) but in other specimens (usually a mountain form) often directed straight caudad; median, apicoventral area with a conspicuous process directed caudad initially, then abruptly curving left, the curve in ventral aspect usually 90 degrees but as much as 150 degrees in some specimens; a prominent slender process arising at approximately the midlength of right ventrolateral area directed caudad primarily, apex usually curving ventrad in typical specimens but continuing straight in mountain forms; dorsal periandrium with a slender, acute, apical process directed right-cephalad in dorsal view. Flagellum in ventral aspect appearing to make a complete loop; typical forms with inner process of flagellum subequally forked, but mountain forms not forked or but feebly so; outer left margin of flagellum with long, slender process following flagellar contour; apex of flagellum with two long, moderately slender, subequal processes. Styles as in figures 188 and 189; slightly asymmetrical; broadly expanded distal half, partly recurved, with apex of recurved portion of right style more bluntly rounded than corresponding part of left style, respective apices terminating at midlength of style; inner processes moderately short, very slender, fingerlike, primarily directed outward, but curving slightly caudad at apex; each process arising entirely near midlength on slender shaft. Connective as in figure 281; moderately long and slender; combined width of ventral arms approximately equal to width of base in posterior view. Pygofer as in figures 320, 372, and 373; slightly asymmetrical; medioventral process in ventral aspect subtriangular, slightly longer than wide, extending posteriorly less than half the distance to level of left pygofer lobe; pygofer lobes well produced, the left more so than the right; posterior margins undulate in lateral view. Anal segment as in figures 426, 471, and 521; in dorsal aspect slightly asymmetrical, distinctly longer than broad, medioapical margin concave; in caudal view hoodlike, with ventral profile concave to a varying degree.

Oliarus californicus Van Duzee is a member of the O. aridus Ball group. Characters of the style will separate californicus from other species of Oliarus. The outstanding feature of the style is the slender inner process that is not attached to any part of the distal expansion but only on the shaft of the style at midlength. Also noteworthy is the elongate distal expansion of the style. The aedeagal complex, with its total of nine processes and characteristic positions and shapes of these processes, also is decisive in diagnosis, but variation in the aedeagal complex can be a source of confusion. Typical forms from the San Diego area have the inner process of the flagellum forked, but in most forms collected in and beyond mountain ranges to the north and east of San Diego this process is simple. The more distal right lateroventral process of the periandrium is usually longer and more slender in the mountain forms than in typical forms from San Diego. The left apicoventral process of the periandrium in the mountain forms is usually straight and directed caudad; in the typical forms it is curved and directed ventrad primarily.

The type material of *Oliarus californicus* Van Duzee is in the California Academy of Sciences. Van Duzee did not list a definite number of type specimens, nor a holotype; he simply stated that the species was "described from many specimens of both sexes taken at most all places where I have collected in San Diego County, from May to October." I have examined three males and four females of the type series. One of the females, on the same pin with a male, is not *californicus* in the sense of my interpretation, but is *O. fidus* Van Duzee. This mixed pair was collected at San Diego, California, June 6, 1914 (E. P. Van Duzee). Before his untimely death Van Duzee had placed paratype labels on this and other pairs of specimens of *californicus*, and he had selected a lectotype but did not publish this designation. Ball (1934) listed the range of *californicus* as the southwestern United States. Numerous specimens from Arizona in the *californicus* unit tray of the United States National Museum were determined by Ball. In my opinion none of the Arizona specimens are californicus but are mostly the closely related species treated in the present paper as Oliarus kieferi, new species. The above facts make it desirable to designate a lectotype for californicus, so the specimen illustrated in this revision is hereby selected as lectotype. This is a male having a yellow "paratype" label placed on it by Van Duzee. The top label on the pin is machine printed "SanDiegoCalif" on the top line, "EPVanDuzee" on the bottom line, and hand printed "6-16-14" in the space between. This specimen formerly was a part of the "EPVanDuzee Collection" but now is in the California Academy of Sciences collection at San Francisco. The apices of the tegmina and wings are damaged. Also on the pin with the lectotype is the misidentified "paratype" female of californicus which actually is fidus Van Duzee. The F. W. Mead Specimen No. III-166510 label refers to the male lectotype. A lectotype label has been placed at the bottom of the pin.

The known distribution of Oliarus californicus Van Duzee is confined to Riverside and San Diego Counties, California. Forms of this species were collected at San Diego and Cuyamaca Rancho State Park in San Diego County. Specimens from Alpine, San Diego County, were slightly transitional but mostly agreed in morphology with the mountain form. Other mountain forms from San Diego and Riverside Counties include specimens from Santa Rosa Mountains; Pinon Flat, Santa Rosa Mountains; Anza; Pine Flats Camp, Indio; Jacumba; and Beaumont.

Specific habitat or host information on Oliarus californicus Van Duzee is scarce. The specimen from Anza, California, was swept from

Arctostaphylos pungens Humboldt, Bonpland, and Kunth. The common name for this plant species is Mexican manzanita.

Although Van Duzee listed *O. californicus* from May to October, the specimens seen by me were collected only from June to September.

FIGURES

Species of <u>Oliarus</u>

Figure 1. Styles and connective of <u>eximus</u> Caldwell

Figure 2. Right tegmen of <u>vicarius</u> (Walker)

Figure 3. Dorsal habitus of <u>sonoitus</u> Ball

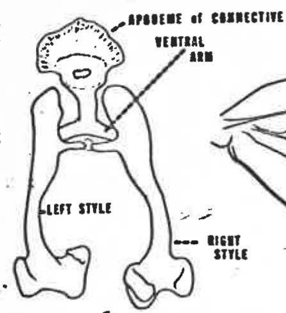
Figure 4. Right wing of <u>vicarius</u> (Walker)

Figure 5. Metatarsites of <u>hesperius</u> Van Duzee

Figure 6. Aedeagal complex, dorsal view of <u>kieferi</u>, new species

Figure 7. Aedeagal complex, ventral view of <u>uncatus</u> Caldwell

Figure 8. Metatibia of <u>hesperius</u> Van Duzee



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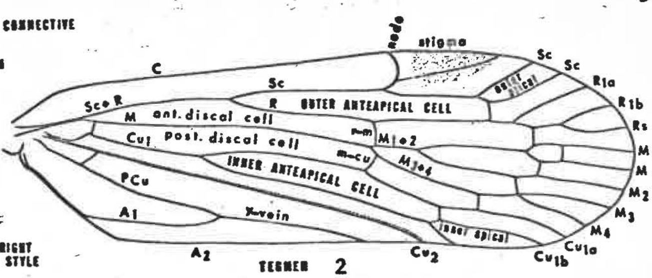
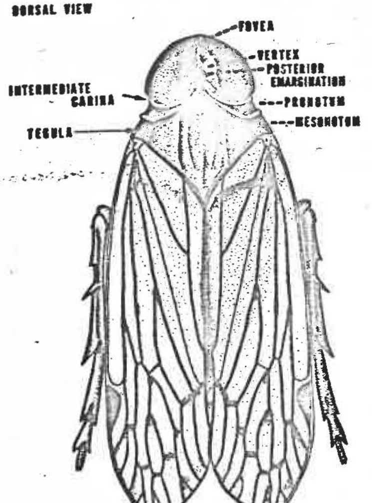
DORSAL VIEW



TEGMEN 2



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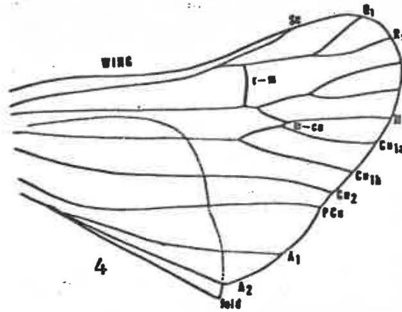

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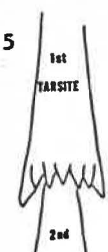

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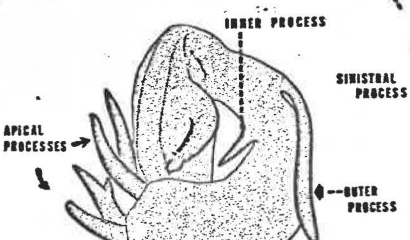
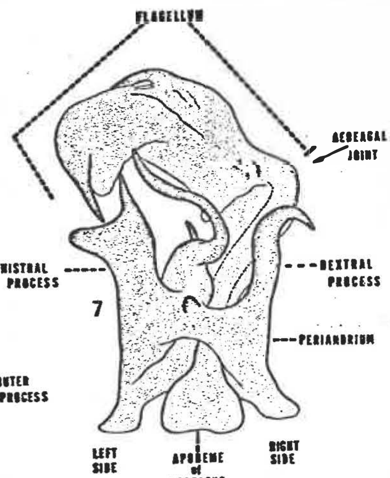


6

RIGHT SIDE
LEFT SIDE
DORSAL VIEW



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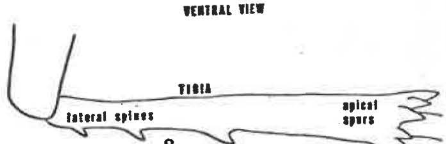
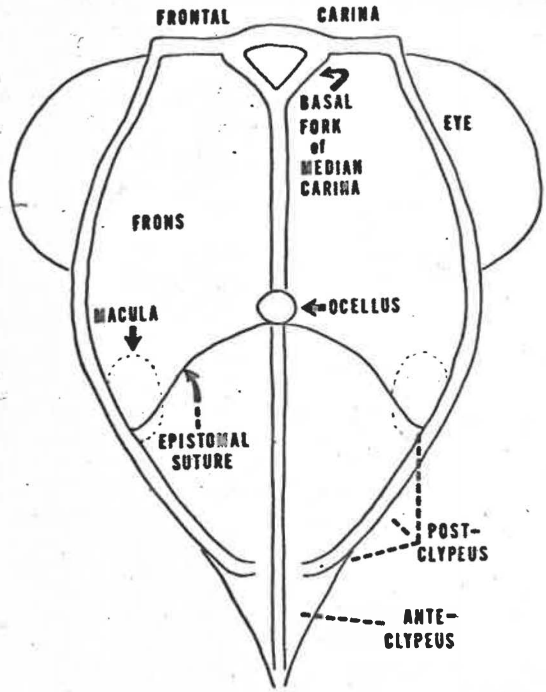
VENTRAL VIEW



8

Anatomy of <u>Oliarus</u>

Figure 9. Face (diagrammatic)


FRONTAL CARINA
BASAL FORK of MEDIAN CARINA
EYE
FRONS
OCELLUS
MACULA
EPISTOMAL SUTURE
POST-CLYPEUS
ANTE-CLYPEUS

9

Species of *Oliarus*

Figure 10. Pygofer, left lateral view of *complectus* Ball

Figure 11. Pygofer, right lateral view of *complectus* Ball

Figure 12. Pygofer, left lateral view of *viequensis* Caldwell

Figure 13. Pygofer, left lateral view of *acicus* Caldwell

Figure 14. Pygofer, right lateral view of *acicus* Caldwell

Figure 15. Pygofer, left lateral view of *exoptatus* Van Duzee

Figure 16. Pygofer, right lateral view of *exoptatus* Van Duzee

Figure 17. Pygofer, left lateral view of *beirnei*, new name

Figure 18. Pygofer, left lateral view of *fidus* Van Duzee

Figure 19. Pygofer, left lateral view of *altanatus* Caldwell

Figure 20. Pygofer, left lateral view of *corvinus* Ball

Figure 21. Pygofer, left lateral view of *littoralis* Ball

Figure 22. Pygofer, left lateral view of *sylvaticus* Caldwell

Figure 23. Pygofer, left lateral view of *dondonius* Ball

Figure 24. Pygofer, left lateral view of *zyxus* Caldwell

Figure 25. Head and thorax, dorsal view of *texanus* Metcalf

Figure 26. Head, frontal view of *texanus* Metcalf

Figure 27. Head and thorax, dorsal view of *chuliotus* Ball

Figure 28. Head and thorax, dorsal view of *dondonius* Ball

Figure 29. Head and thorax, dorsal view of *canyonensis*, new species

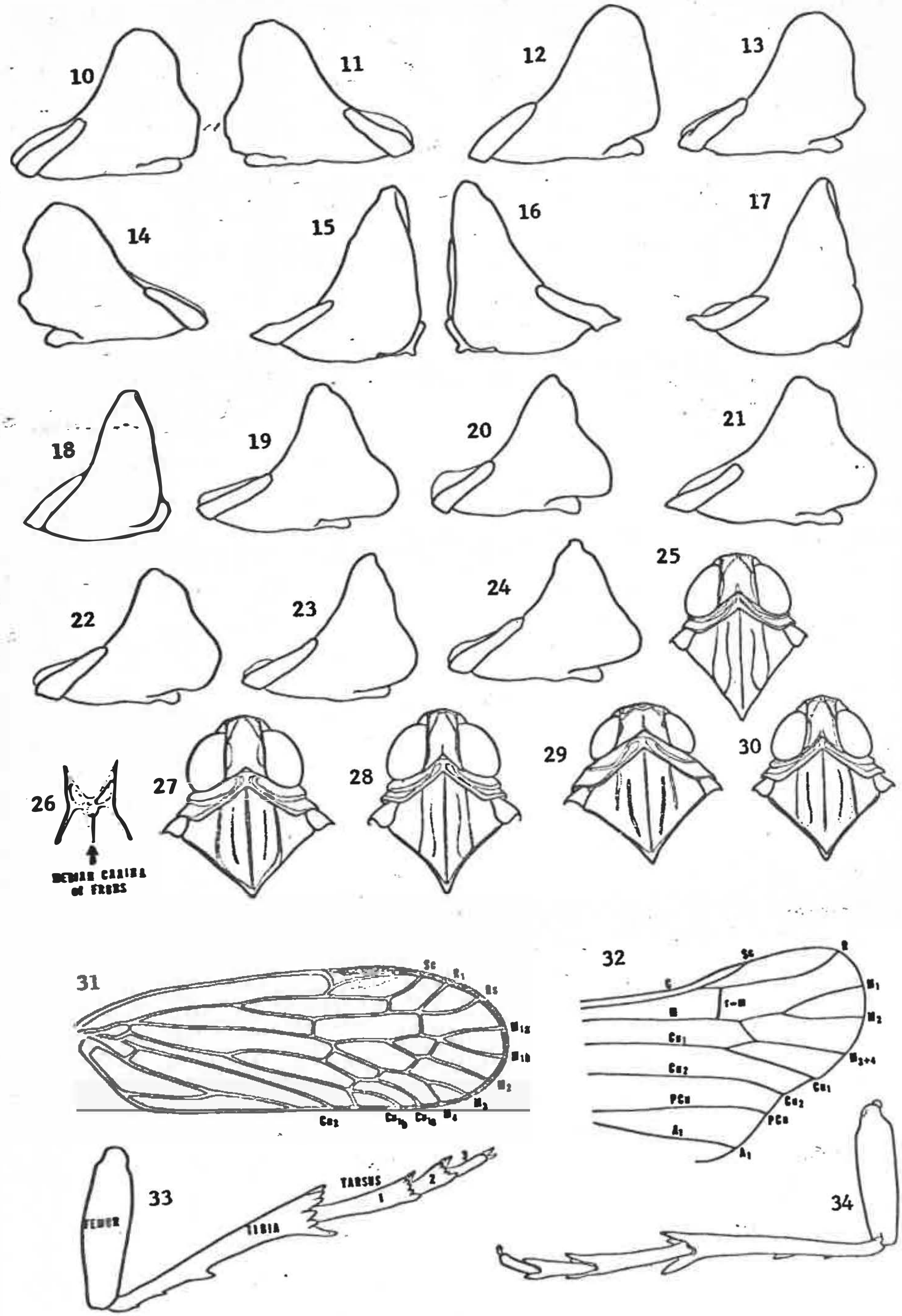
Figure 30. Head and thorax, dorsal view of *altanatus* Caldwell

Figure 31. Right tegmen, venation of *canyonensis*, new species

Figure 32. Right wing, venation of *canyonensis*, new species

Figure 33. Posterior leg of *yavapanus* Ball

Figure 34. Posterior leg of *hesperius* Van Duzee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MEDIAN CARINA OF FRONS
27
28
29
30
31
Sc
R1
Rs
M2
M3
M4
Cu2
32
Sc
R
C
M
r-m
M1
M2
Cu1
Cu2
M3+4
PCu
A1
33
FEMUR
TIBIA
TARSUS
1
2
3
34

Species of _Oliarus_; aedeagal complexes

Figure 35. Ventral view of _aridus_ Ball

Figure 36. Dorsal view of _aridus_ Ball

Figure 37. Dorsal view of _hesperius_ Van Duzee

Figure 38. Ventral view of _hesperius_ Van Duzee

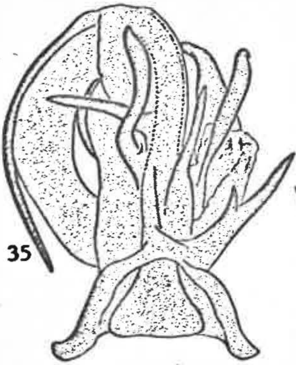
Figure 39. Ventral view of _aridus_ Ball; form from Cameron County, Texas

Figure 40. Ventral view of _kieferi,_ new species; holotype

Figure 41. Dorsal view of _kieferi,_ new species; holotype

Figure 42. Dorsal view of _pima_ Kirkaldy

Figure 43. Ventral view of _pima_ Kirkaldy



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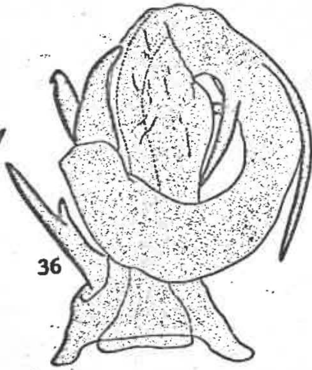

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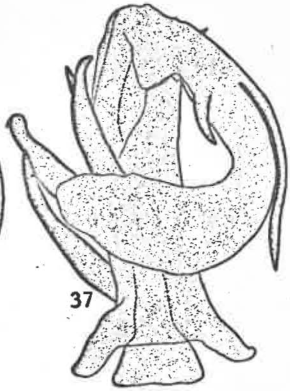

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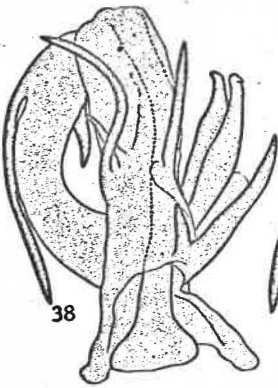

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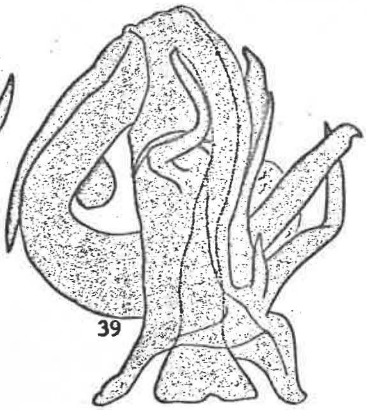

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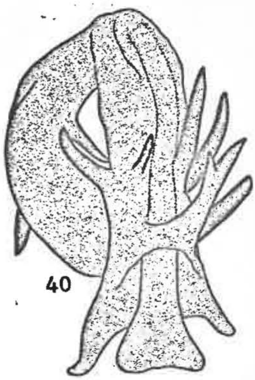

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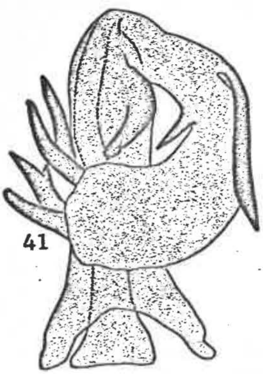

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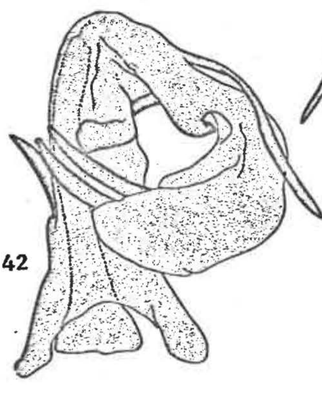

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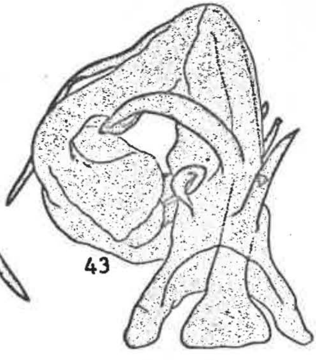


43

Species of Oliarus; aedeagal complexes

Figure 44. Ventral view of sonoitus Ball

Figure 45. Dorsal view of sonoitus Ball

Figure 46. Ventral view of californicus Van Duzee; form from Santa Rosa Mountains, California

Figure 47. Ventral view of californicus Van Duzee; typical form

Figure 48. Dorsal view of californicus Van Duzee

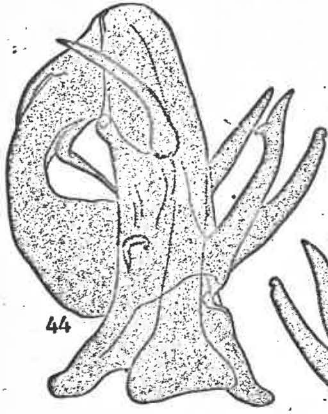
Figure 49. Ventral view of knullorum, new species; holotype

Figure 50. Right lateral view of dextral process of knullorum, new species

Figure 51. Dorsal view of knullorum, new species; holotype

Figure 52. Ventral view of sementinus Ball

Figure 53. Dorsal view of sementinus Ball



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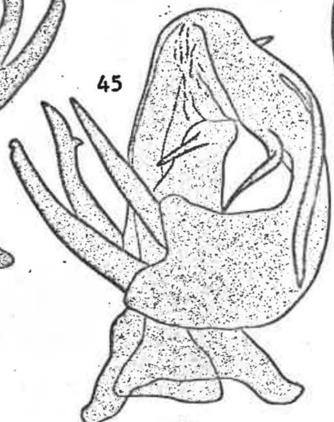

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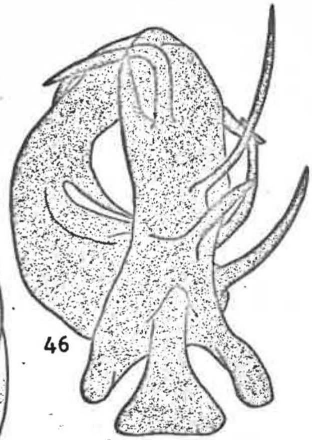

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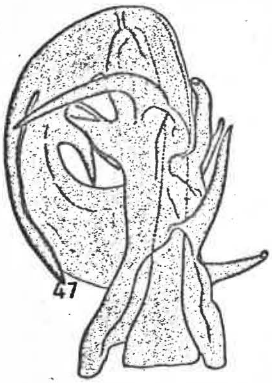

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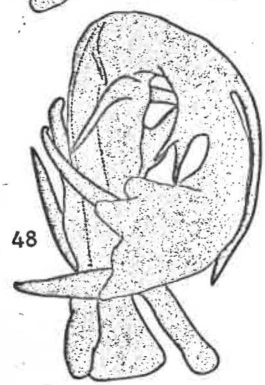

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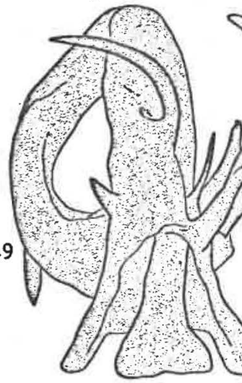

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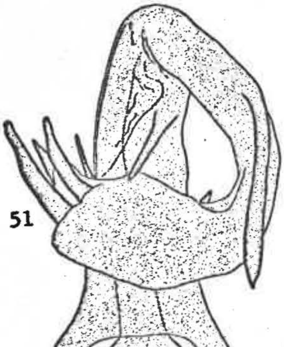

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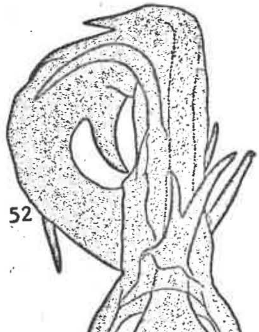

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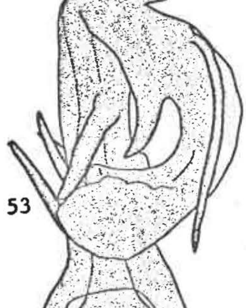

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Species of *Oliarus*; aedeagal complexes

Figure 54. Ventral view of *canyonensis*, new species; holotype

Figure 55. Dorsal view of *canyonensis*, new species; holotype

Figure 56. Ventral view of *retentus* Caldwell

Figure 57. Dorsal view of *retentus* Caldwell

Figure 58. Ventral view of *truncatus* Van Duzee

Figure 59. Dorsal view of *truncatus* Van Duzee

Figure 60. Ventral view of *apache* Ball

Figure 61. Dorsal view of *apache* Ball

Figure 62. Ventral view of *papagonus* Ball

54 55 56 57 58 59 60 61 62

Species of _Oliarus_; aedeagal complexes

Figure 63. Dorsal view of _papagonus_ Ball

Figure 64. Ventral view of _caldwelli_, new species; holotype

Figure 65. Dorsal view of _caldwelli_, new species; holotype

Figure 66. Ventral view of _lobatus_ Caldwell

Figure 67. Dorsal view of _lobatus_ Caldwell

Figure 68. Ventral view of _habeckorum_, new species; holotype

Figure 69. Dorsal view of _habeckorum_, new species; holotype

Figure 70. Dorsal view of _cinnamomeus_ Provancher

Figure 71. Ventral view of _cinnamomeus_ Provancher

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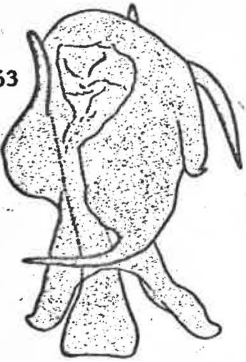

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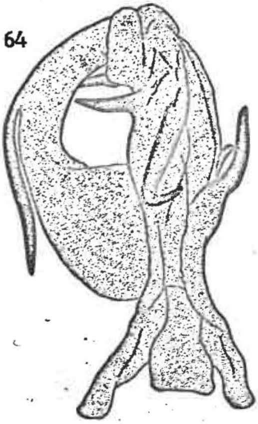

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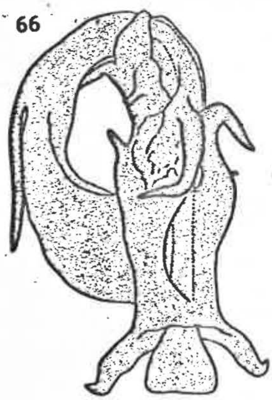

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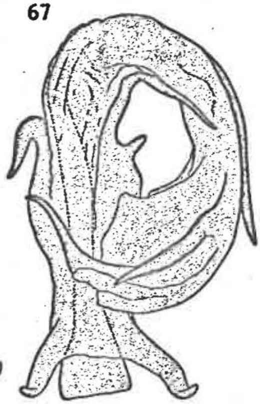

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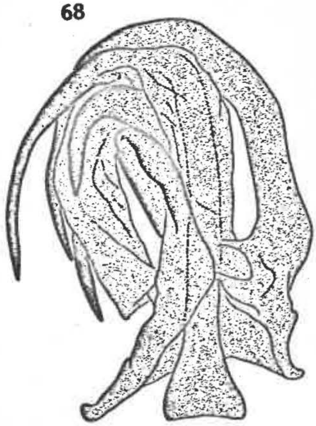

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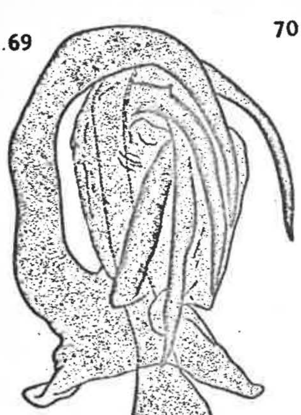

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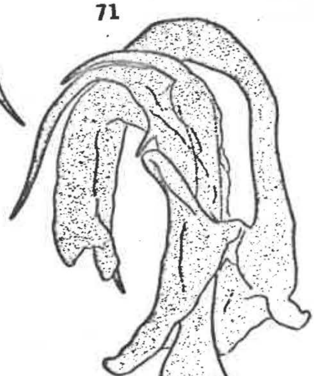


Species of _Oliarus_; aedeagal complexes

Figure 72. Ventral view of _slossonae_ Van Duzee

Figure 73. Dorsal view of _slossonae_ Van Duzee

Figure 74. Ventral view of _quinquelineatus_ (Say)

Figure 75. Ventral view of _vicarius_ (Walker)

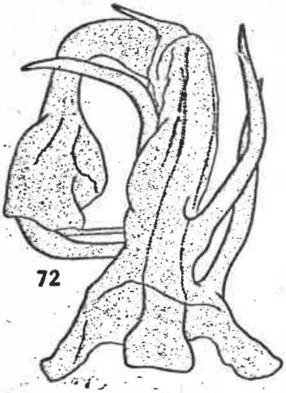
Figure 76. Dorsal view of _vicarius_ (Walker)

Figure 77. Ventral view of _humilis_ (Say)

Figure 78. Dorsal view of _humilis_ (Say)

Figure 79. Ventral view of _difficilis_ Van Duzee

Figure 80. Dorsal view of _difficilis_ Van Duzee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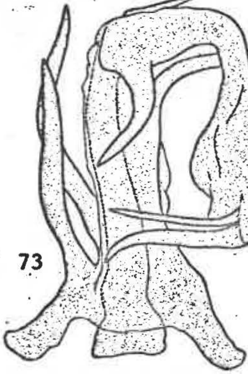
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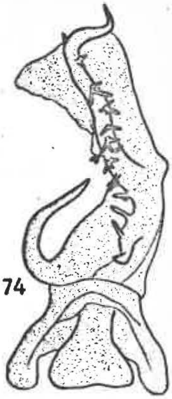
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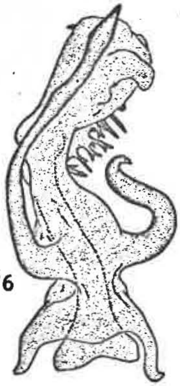
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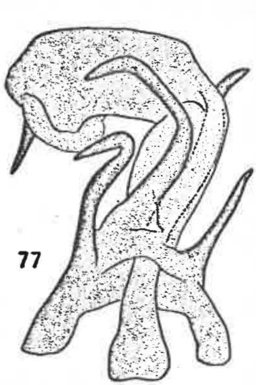
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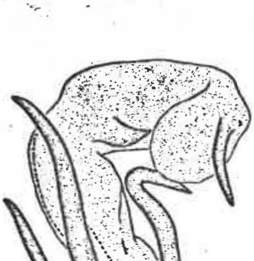
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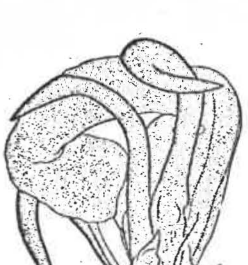
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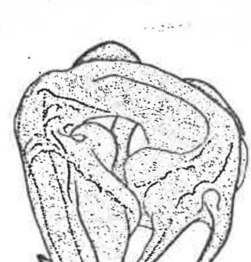
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Species of *Oliarus*; aedeagal complexes

Figure 81. Ventral view of *teximus* Caldwell

Figure 82. Dorsal view of *teximus* Caldwell

Figure 83. Ventral view of *teximus* Caldwell; form from Dallas, Texas

Figure 84. Ventral view of *eximus* Caldwell

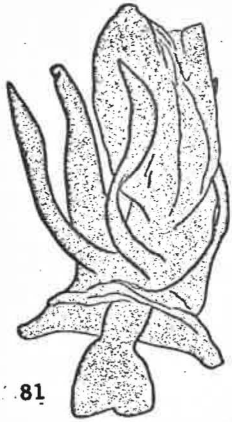
Figure 85. Dorsal view of *eximus* Caldwell

Figure 86. Dorsal view of *placitus* Van Duzee

Figure 87. Ventral view of *montanus* Metcalf

Figure 88. Left dorsolateral view of *montanus* Metcalf

Figure 89. Ventral view of *placitus* Van Duzee



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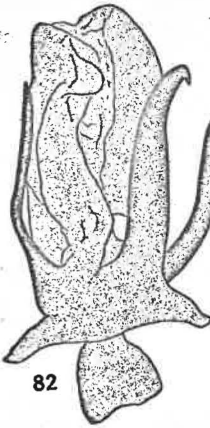

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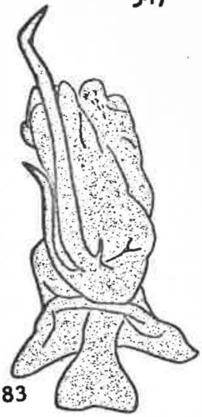

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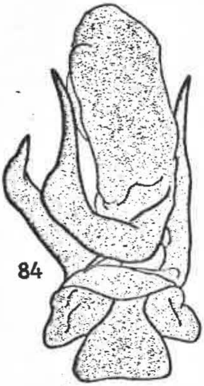

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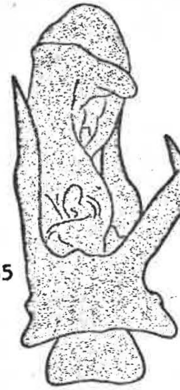

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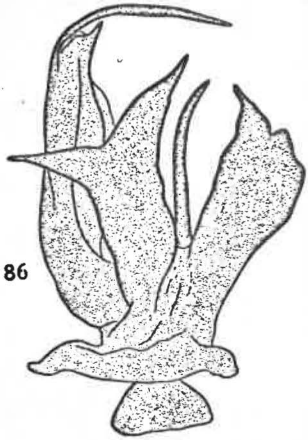

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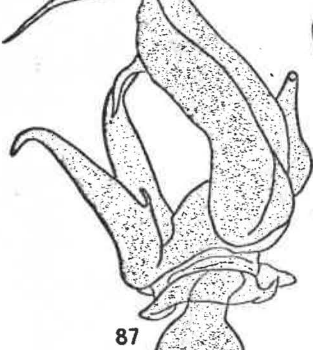

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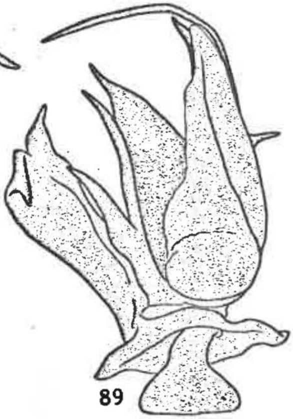

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Species of *Oliarus*; aedeagal complexes

Figure 90. Ventral view of *texanus* Metcalf

Figure 91. Dorsal view of *texanus* Metcalf

Figure 92. Ventral view of *yavapanus* Ball

Figure 93. Dorsal view of *yavapanus* Ball

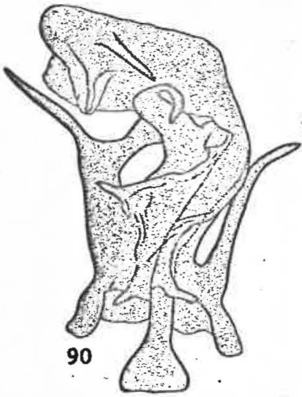
Figure 94. Ventral view of *uncatus* Caldwell

Figure 95. Dorsal view of *uncatus* Caldwell

Figure 96. Ventral view of *forcipatus* Caldwell

Figure 97. Dorsal view of *forcipatus* Caldwell

Figure 98. Ventral view of *arizonensis*, new species; paratype from Tubac, Arizona



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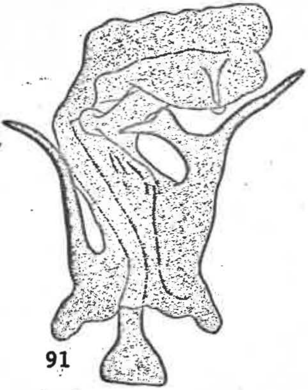

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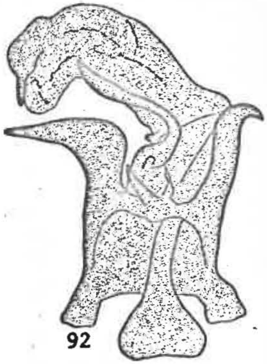

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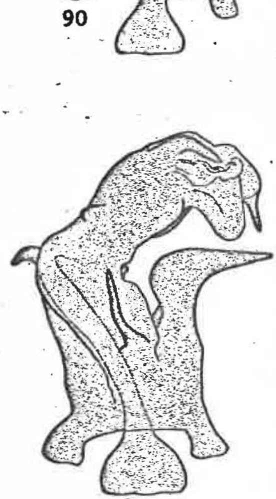

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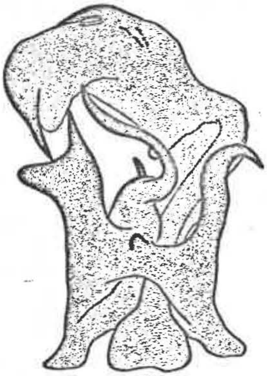

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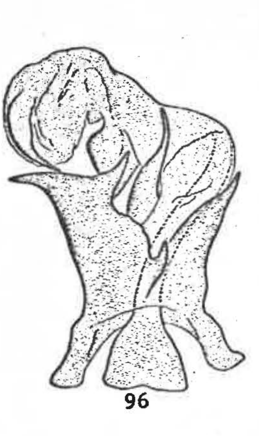

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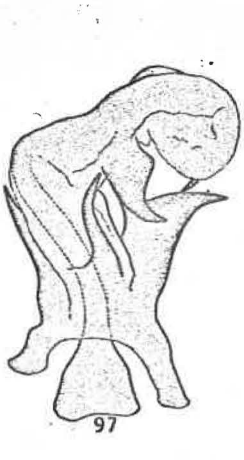

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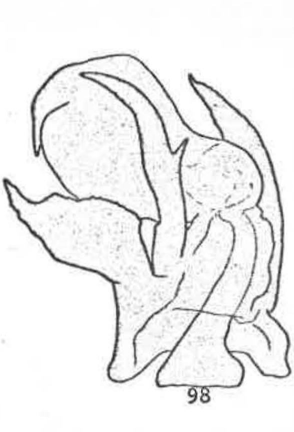

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Species of Oliarus; aedeagal complexes

Figure 99. Ventral view of arizonensis, new species; holotype

Figure 100. Ventral view of pygmaeus Ball

Figure 101. Left lateral view of pygmaeus Ball

Figure 102. Ventral view of altanus Ball; from allotype-paratype series

Figure 103. Ventral view of apex of sinistral process of altanus; from allotype-paratype series

Figure 104. Dorsal view of altanus Ball; from allotype-paratype series

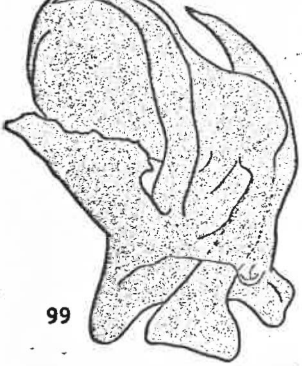
Figure 105. Ventral view of apex of sinistral process of altanus; from allotype-paratype series

Figure 106. Ventral view of coconinus Ball

Figure 107. Dorsal view of coconinus Ball

Figure 108. Ventral view of catus Caldwell

Figure 109. Dorsal view of catus Caldwell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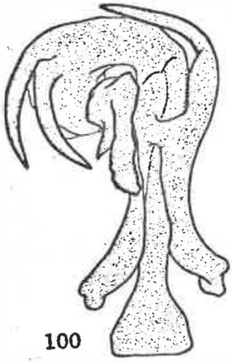
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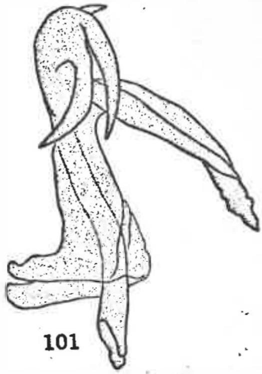
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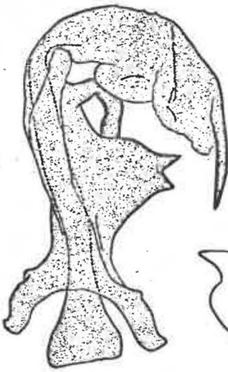
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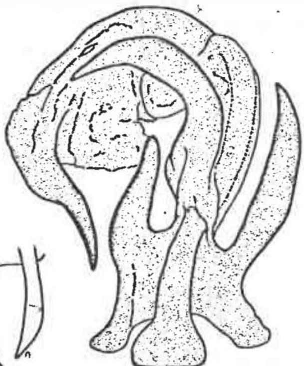
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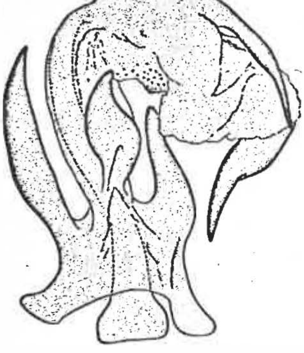
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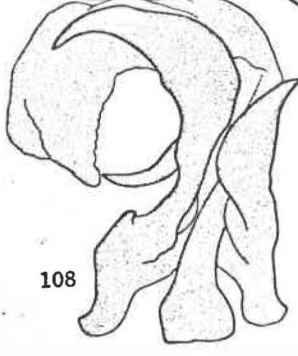
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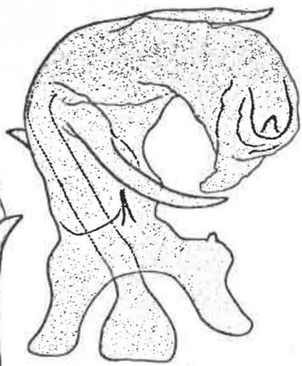
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Species of *Oliarus*; aedeagal complexes

Figure 110. Ventral view of *bispinus* Caldwell

Figure 111. Dorsal view of *bispinus* Caldwell

Figure 112. Ventral view of *sablensis* Caldwell

Figure 113. Dorsal view of *sablensis* Caldwell

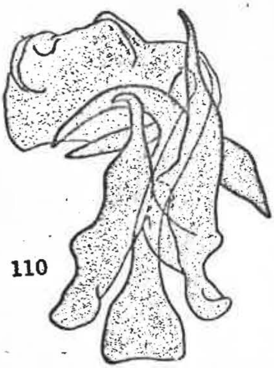
Figure 114. Ventral view of *chuliotus* Ball

Figure 115. Dorsal view of *chuliotus* Ball

Figure 116. Ventral view of *ecologus* Caldwell

Figure 117. Dorsal view of *ecologus* Caldwell

Figure 118. Dorsal view of *chuliotus* Ball; form from Hocking Company, Ohio



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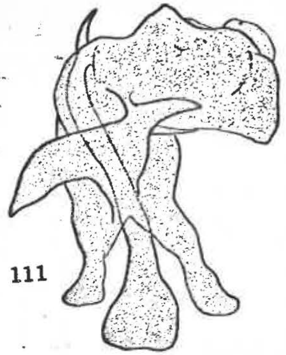

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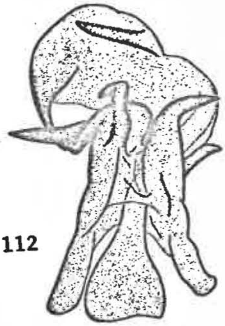

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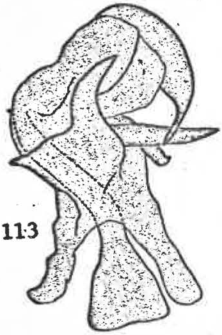

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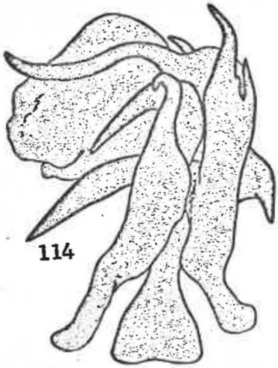

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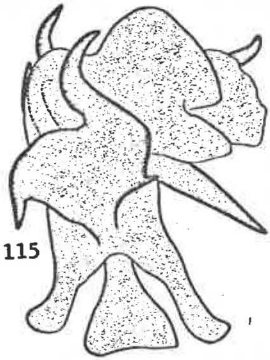

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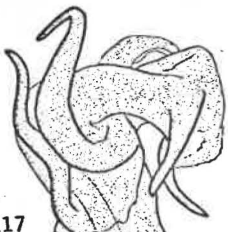

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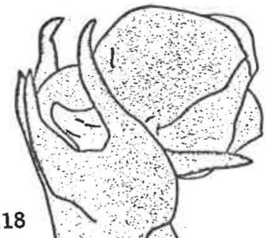

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Species of _Oliarus_; aedeagal complexes

Figure 119. Ventral view of _complectus_ Ball

Figure 120. Dorsal view of _complectus_ Ball

Figure 121. Ventral view of _viequensis_ Caldwell

Figure 122. Dorsal view of _viequensis_ Caldwell

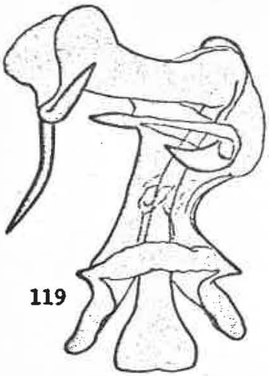
Figure 123. Ventral view of _acicus_ Caldwell

Figure 124. Right lateral view of _acicus_ Caldwell

Figure 125. Ventral view of _exoptatus_ Van Duzee

Figure 126. Dorsal view of _exoptatus_ Van Duzee

Figure 127. Ventral view of _beirnei_, new name



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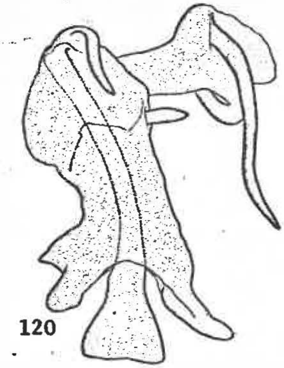

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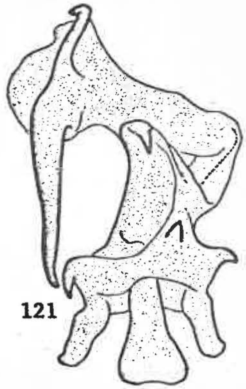

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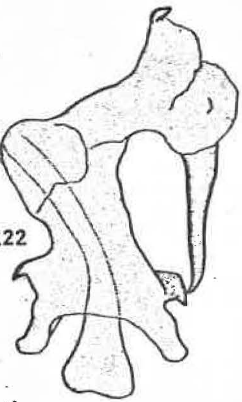

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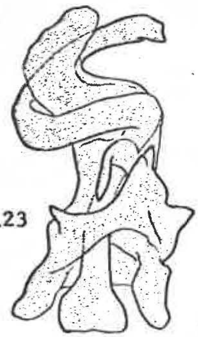

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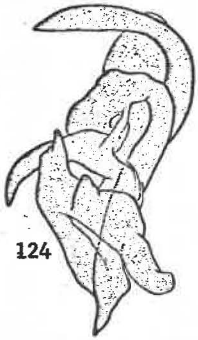

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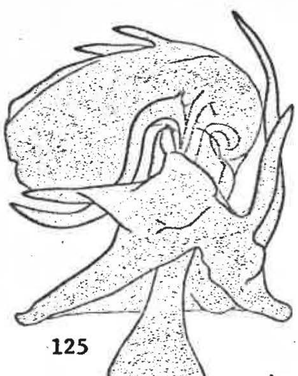

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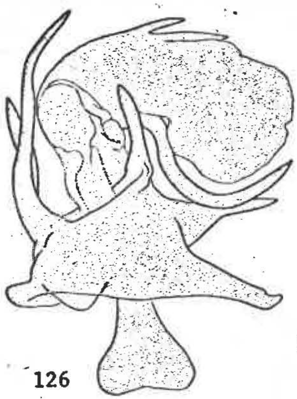

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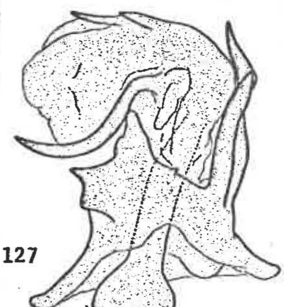

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Species of _Oliarus_; aedeagal complexes

Figure 128. Dorsal view of _beirnei_, new name

Figure 129. Ventral view of _fidus_ Van Duzee

Figure 130. Dorsal view of _fidus_ Van Duzee

Figure 131. Ventral view of _altanatus_ Caldwell

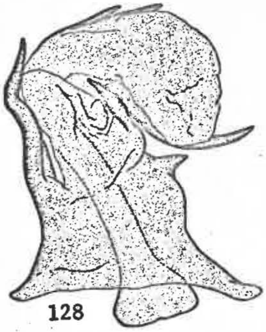
Figure 132. Dorsal view of _altanatus_ Caldwell

Figure 133. Ventral view of _corvinus_ Ball

Figure 134. Dorsal view of _corvinus_ Ball

Figure 135. Ventral view of _littoralis_ Ball

Figure 136. Dorsal view of _littoralis_ Ball



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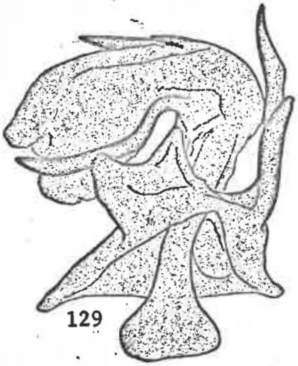

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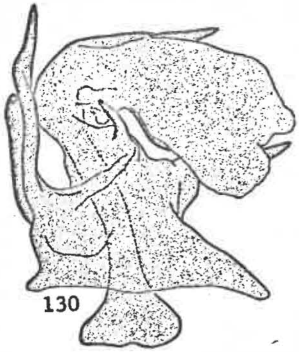

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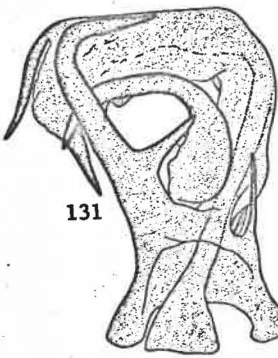

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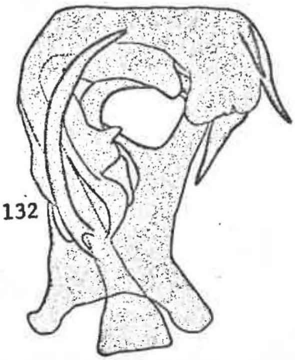

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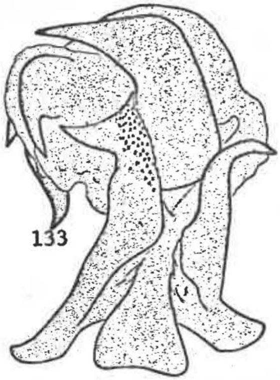

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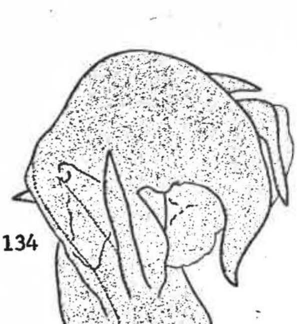

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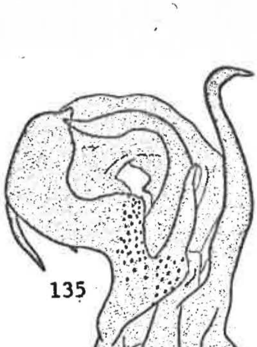

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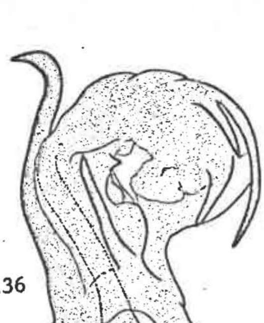

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Species of <u>Oliarus</u>

Figure 137. Aedeagal complex, ventral of *sylvaticus* Caldwell

Figure 138. Aedeagal complex, dorsal of *sylvaticus* Caldwell

Figure 139. Sinistral process, ventral of *dondonius* Ball; form from Sacramento, California

Figure 140. Aedeagal complex, ventral of *dondonius* Ball

Figure 141. Aedeagal complex, dorsal of *dondonius* Ball

Figure 142. Sinistral process, ventral of *dondonius* Ball; form from Los Banos, California

Figure 143. Aedeagal complex, ventral of *dondonius* Ball; form from Mendota, California

Figure 144. Sinistral process, ventral of *dondonius* Ball; form from Chaves, New Mexico

Figure 145. Left style of *littoralis* Ball

Figure 146. Right style of *littoralis* Ball

Figure 147. Left style of *sylvaticus* Caldwell

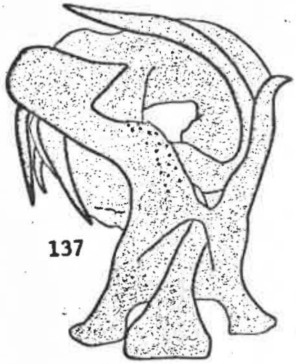
Figure 148. Right style of *sylvaticus* Caldwell

Figure 149. Left style of *dondonius* Ball

Figure 150. Right style of *dondonius* Ball

Figure 151. Left style of *zyxus* Caldwell

Figure 152. Right style of *zyxus* Caldwell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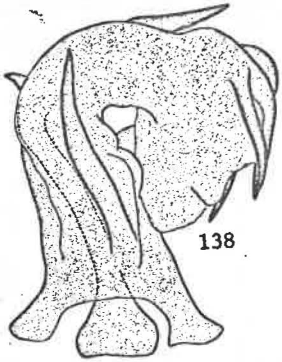
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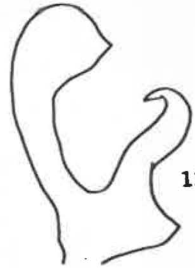
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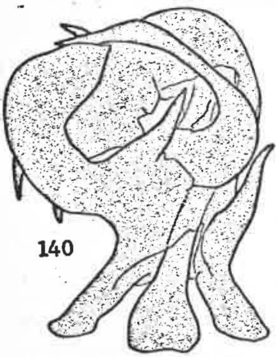
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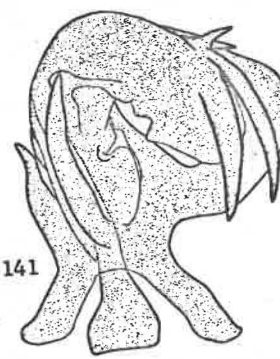
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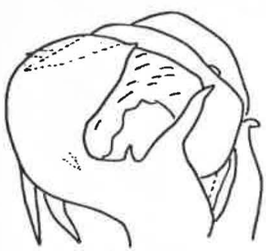
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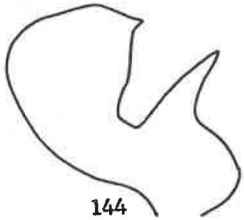
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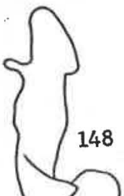
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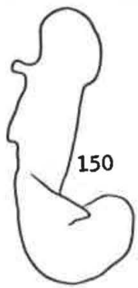
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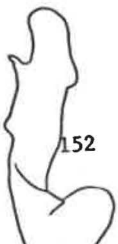
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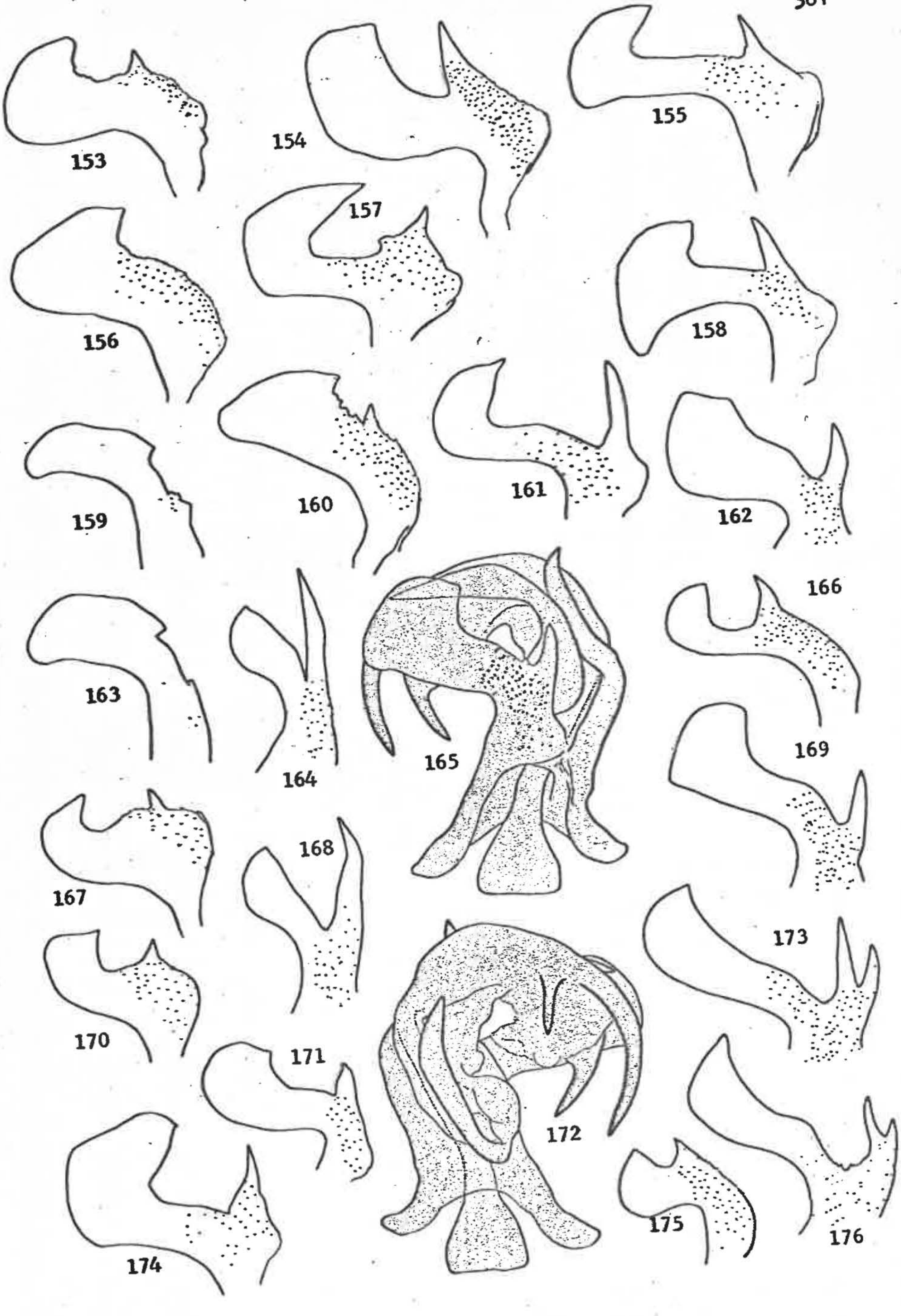
Oliarus zyxus Caldwell; aedeagal complex and variations of the sinistral process of the aedeagal complex in ventral view

Figure 153. Vernon, British Columbia
Figure 154. Clarion, Idaho
Figure 155. Benjamin, Utah
Figure 156. Medord, Oregon
Figure 157. Carson City, Nevada
Figure 158. Benjamin, Utah
Figure 159. Kern County, California (one mile north of McKittrick)
Figure 160. Shasta County, California
Figure 161. Yavapai County, Arizona
Figure 162. Rodeo, New Mexico
Figure 163. Kern County, California (one mile north of McKittrick)
Figure 164. San Blas, Nayarit, Mexico
Figure 165. Aedeagal complex, ventral view, Torreon, Mexico
Figure 166. Kinney County, Texas
Figure 167. Los Angles County, California
Figure 168. Stanislaus County, California (Del Puerto Canyon)
Figure 169. Val Verde County, Texas
Figure 170. Los Angles County, California
Figure 171. San Diego County, California
Figure 172. Aedeagal complex, dorsal view, Torreon, Mexico
Figure 173. Cedar Lane, Texas
Figure 174. Inyo County, California (Deep Springs)
Figure 175. Val Verde County, Texas
Figure 176. Brownsville, Texas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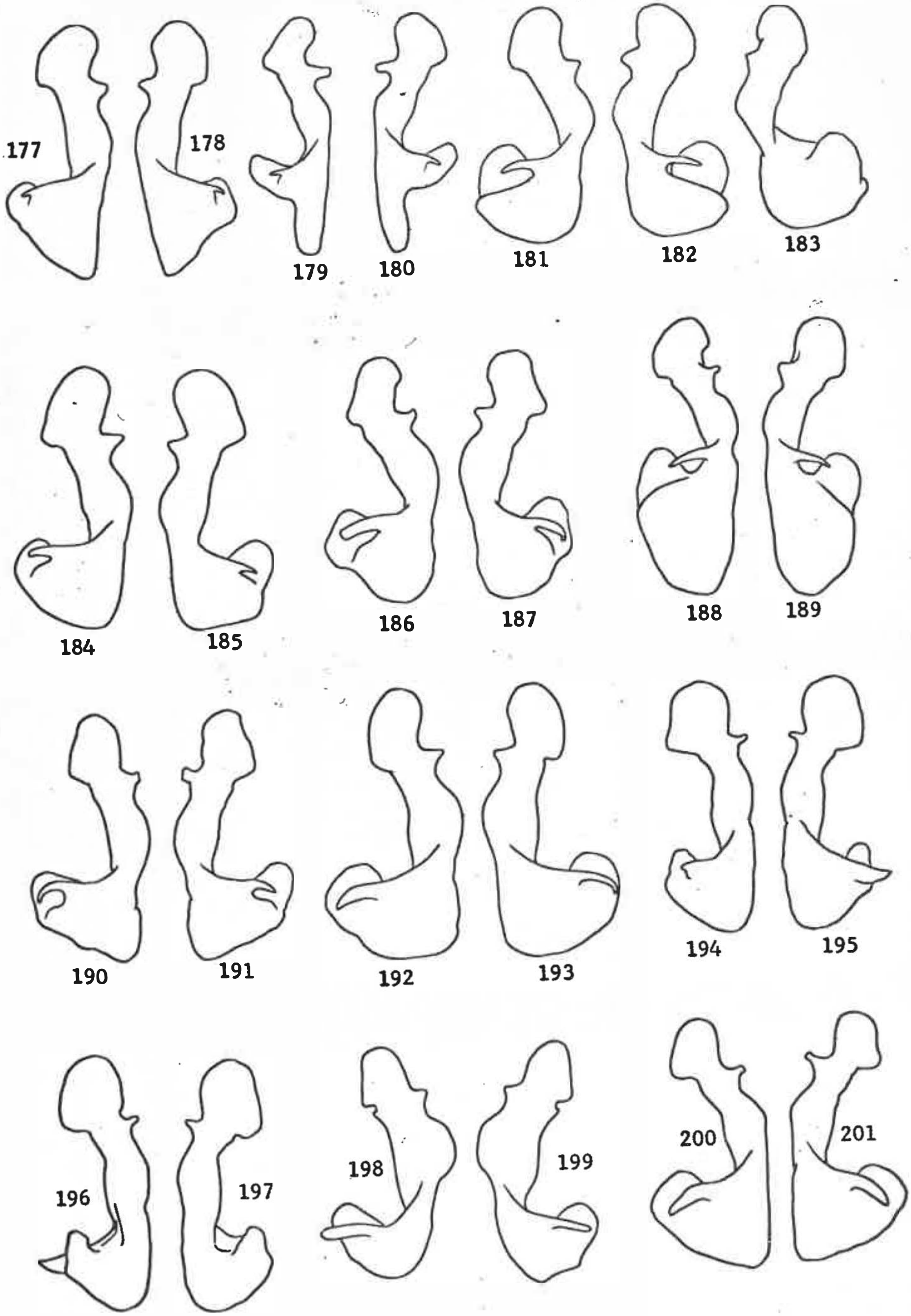
Species of *Oliarus*;
styles in broad, inner aspect, except as noted

Figure 177. Left of *aridus* Ball
Figure 178. Right of *aridus* Ball
Figure 179. Left of *hesperius* Van Duzee
Figure 180. Right of *hesperius* Van Duzee
Figure 181. Left of *kieferi*, new species, holotype
Figure 182. Right of *kieferi*, new species, holotype
Figure 183. Left of *kieferi*, new species; outer aspect of holotype
Figure 184. Left of *pima* Kirkaldy
Figure 185. Right of *pima* Kirkaldy
Figure 186. Left of *sonoitus* Ball
Figure 187. Right of *sonoitus* Ball
Figure 188. Left of *californicus* Van Duzee
Figure 189. Right of *californicus* Van Duzee
Figure 190. Left of *knullorum*, new species; holotype
Figure 191. Right of *knullorum*, new species; holotype
Figure 192. Left of *sementinus* Ball
Figure 193. Right of *sementinus* Ball
Figure 194. Left of *canyonensis*, new species; holotype
Figure 195. Right of *canyonensis*, new species; holotype
Figure 196. Right of *canyonensis*, new species; outer aspect of holotype
Figure 197. Left of *canyonensis*, new species; outer aspect of holotype
Figure 198. Left of *retentus* Caldwell
Figure 199. Right of *retentus* Caldwell
Figure 200. Left of *truncatus* Van Duzee
Figure 201. Right of *truncatus* Van Duzee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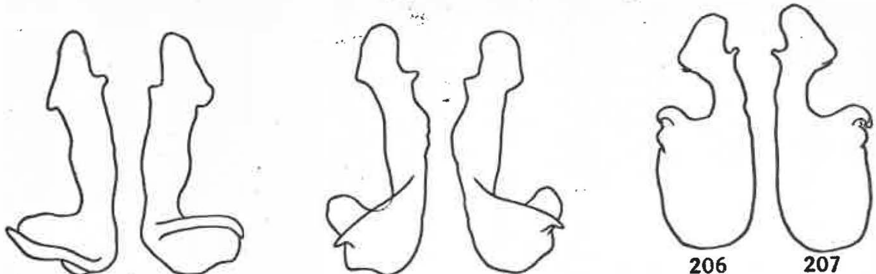
Species of *Oliarus*
styles in broad, inner aspect, except as noted

Figure 202. Left of *apache* Ball
Figure 203. Right of *apache* Ball
Figure 204. Left of *papagonus* Ball
Figure 205. Right of *papagonus* Ball
Figure 206. Left of *caldwelli*, new species; holotype
Figure 207. Right of *caldwelli*, new species; holotype
Figure 208. Left of *lobatus* Caldwell
Figure 209. Right of *lobatus* Caldwell
Figure 210. Left of *habeckorum*, new species; holotype
Figure 211. Right of *habeckorum*, new species; holotype
Figure 212. Left of *habeckorum*, new species; outer aspect of holotype
Figure 213. Left of *cinnamomeus* Provancher
Figure 214. Right of *cinnamomeus* Provancher
Figure 215. Left of *slossonae* Van Duzee
Figure 216. Right of *slossonae* Van Duzee
Figure 217. Left of *quinquelineatus* (Say)
Figure 218. Right of *quinquelineatus* (Say)
Figure 219. Left of *vicarius* (Walker)
Figure 220. Right of *vicarius* (Walker)
Figure 221. Left of *humilis* (Say)
Figure 222. Right of *humilis* (Say)
Figure 223. Left of *difficilis* Van Duzee
Figure 224. Right of *difficilis* Van Duzee
Figure 225. Left of *teximus* Caldwell
Figure 226. Right of *teximus* Caldwell



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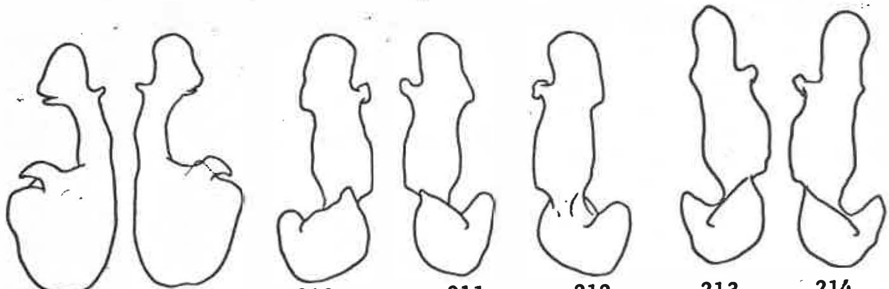

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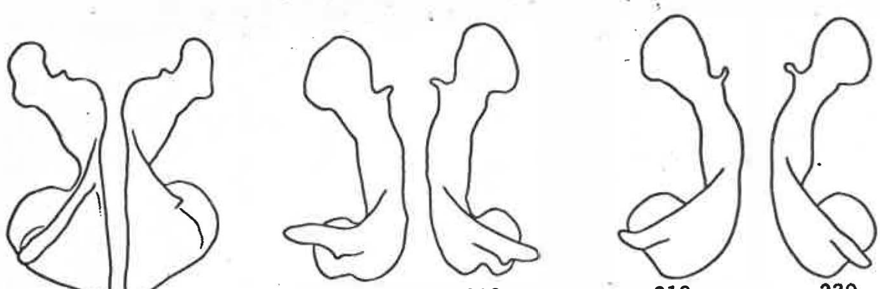

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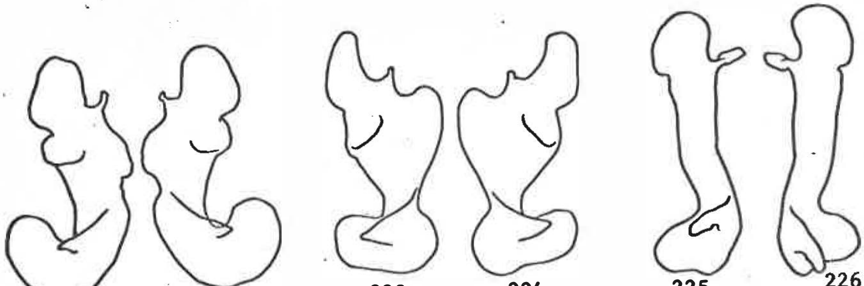

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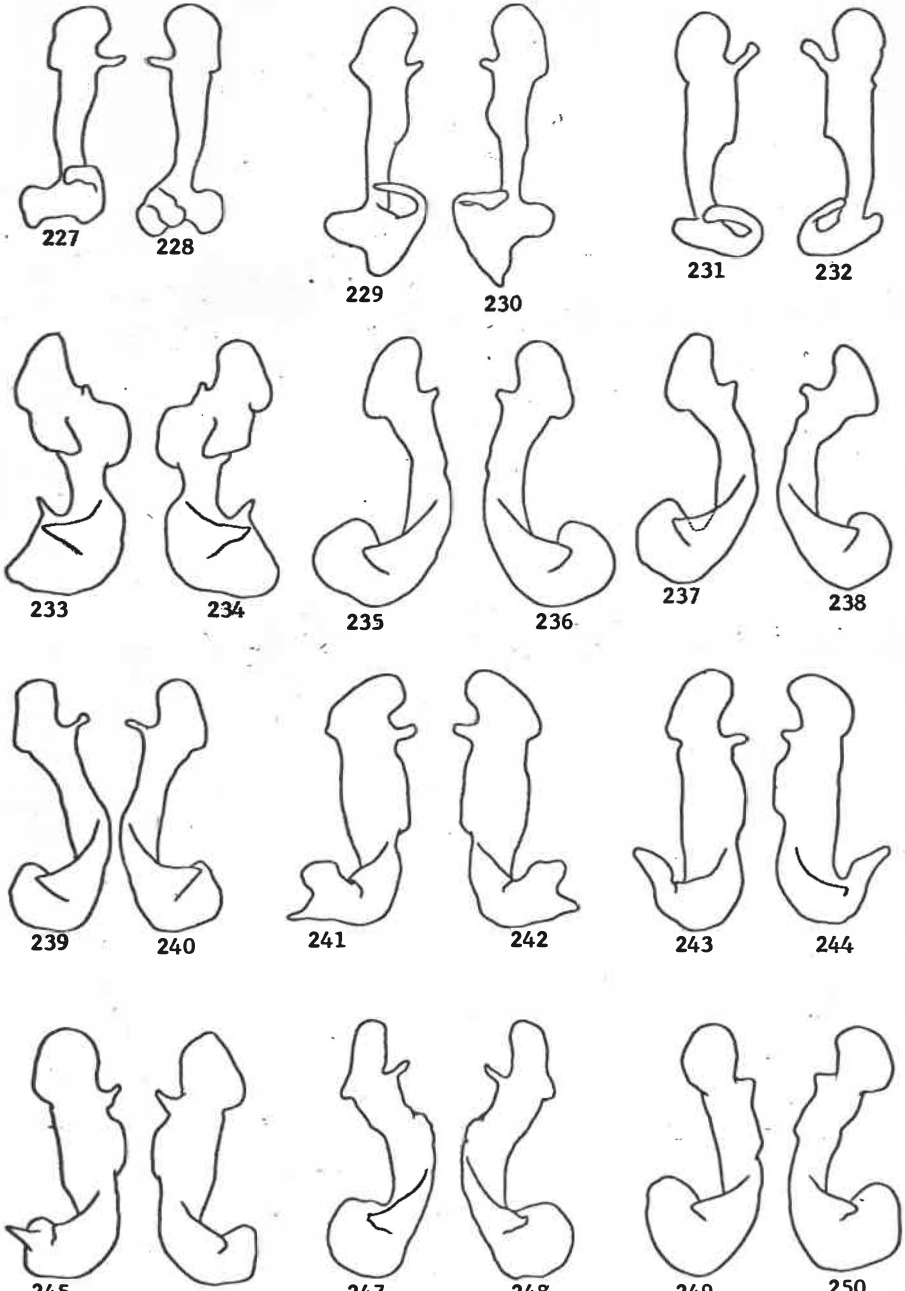
Species of *Oliarus*;
styles in broad, inner aspect

Figure 227. Left of *eximus* Caldwell
Figure 228. Right of *eximus* Caldwell
Figure 229. Left of *placitus* Van Duzee
Figure 230. Right of *placitus* Van Duzee
Figure 231. Left of *montanus* Metcalf
Figure 232. Right of *montanus* Metcalf
Figure 233. Left of *texanus* Metcalf
Figure 234. Right of *texanus* Metcalf
Figure 235. Left of *yavapanus* Ball
Figure 236. Right of *yavapanus* Ball
Figure 237. Left of *uncatus* Caldwell
Figure 238. Right of *uncatus* Caldwell
Figure 239. Left of *forcipatus* Caldwell
Figure 240. Right of *forcipatus* Caldwell
Figure 241. Left of *arizonensis*, new speces; paratype from La Osa River, Arizona
Figure 242. Right of *arizonensis*, new species; paratype from La Osa River, Arizona
Figure 243. Left of *pygmaeus* Ball
Figure 244. Right of *pygmaeus* Ball
Figure 245. Left of *altanus* Ball
Figure 246. Right of *altanus* Ball
Figure 247. Left of *coconinus* Ball
Figure 248. Right of *coconinus* Ball
Figure 249. Left of *catus* Caldwell
Figure 250. Right of *catus* Caldwell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Species of Oliarus;
styles in broad, inner aspect

Figure 251. Left of bispinus Caldwell
Figure 252. Right of bispinus Caldwell
Figure 253. Left of sablensis Caldwell
Figure 254. Right of sablensis Caldwell
Figure 255. Left of chuliotus Ball
Figure 256. Right of chuliotus Ball
Figure 257. Left of ecologus Caldwell
Figure 258. Right of ecologus Caldwell
Figure 259. Left of complectus Ball
Figure 260. Right of complectus Ball
Figure 261. Left of viequensis Caldwell
Figure 262. Right of viequensis Caldwell
Figure 263. Left of acicus Caldwell
Figure 264. Right of acicus Caldwell
Figure 265. Left of exoptatus Van Duzee
Figure 266. Right of exoptatus Van Duzee
Figure 267. Left of beirnei, new name
Figure 268. Right of beirnei, new name
Figure 269. Left of fidus Van Duzee
Figure 270. Right of fidus Van Duzee
Figure 271. Left of altanatus Caldwell
Figure 272. Right of altanatus Caldwell
Figure 273. Left of corvinus Ball
Figure 274. Right of corvinus Ball


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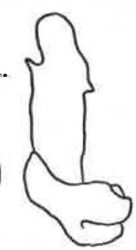
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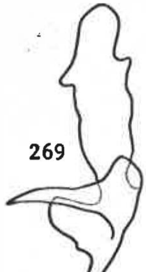
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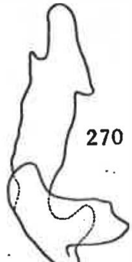
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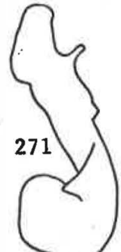
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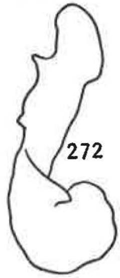
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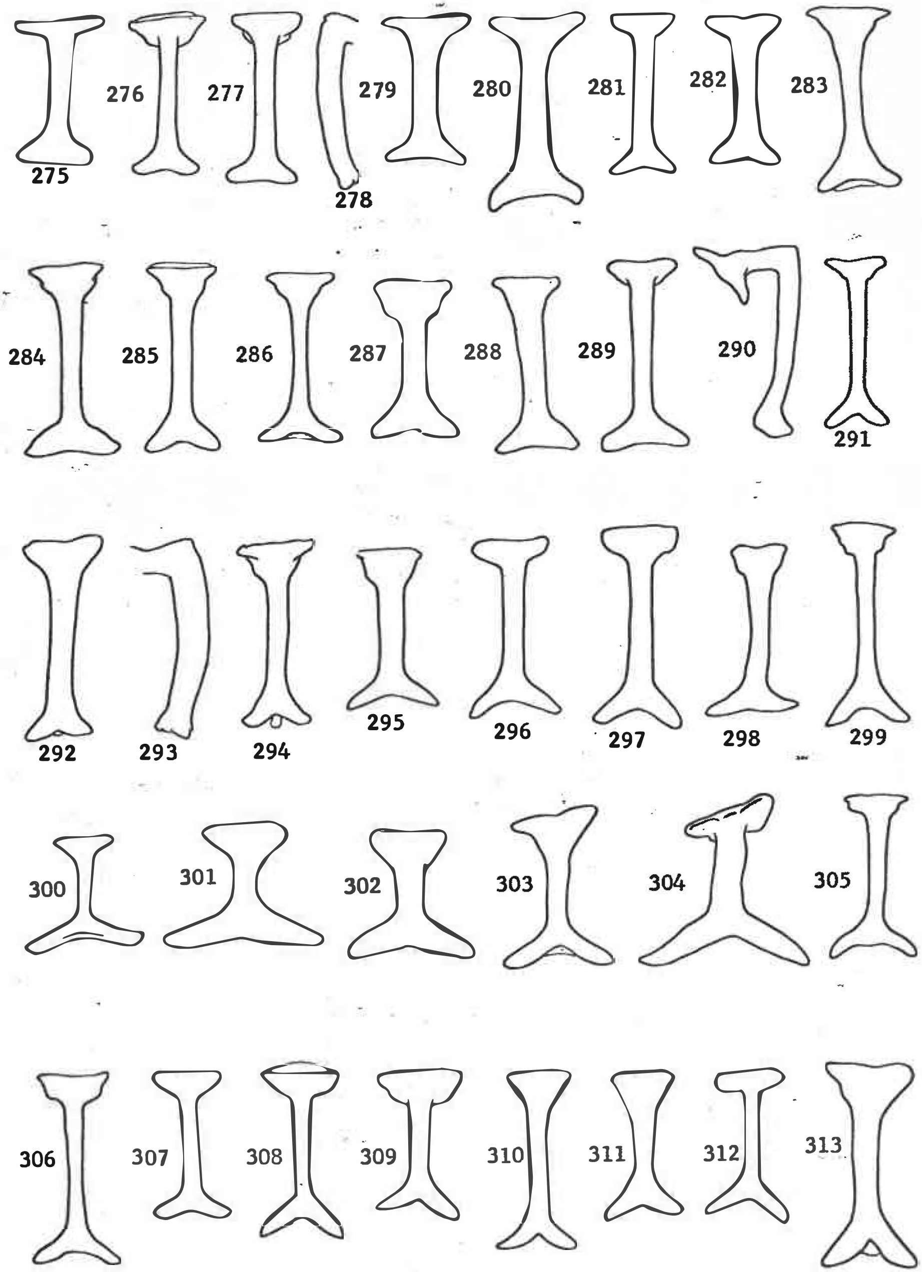
Species of Oliarus;
connective in posterior aspect, except as noted

Figure 275. aridus Ball
Figure 276. hesperius Van Duzee
Figure 277. kieferi, new species; holotype
Figure 278. kieferi, new species; holotype (right lateral aspect)
Figure 279. pima Kirkaldy
Figure 280. sonoitus Ball
Figure 281. californicus Van Duzee
Figure 282. knullorum, new species; holotype
Figure 283. sementinus Ball
Figure 284. canyonensis, new species; holotype
Figure 285. retentus Caldwell
Figure 286. truncatus Van Duzee
Figure 287. apache Ball
Figure 288. papagonus Ball
Figure 289. caldwelli, new species; holotype
Figure 290. caldwelli, new species; holotype (left lateral aspect)
Figure 291. lobatus Caldwell
Figure 292. habeckorum, new species; holotype
Figure 293. habeckorum, new species; holotype (left lateral aspect)
Figure 294. cinnamomeus Provancher
Figure 295. slossonae Van Duzee
Figure 296. quinquelineatus (Say)
Figure 297. vicarius (Walker)
Figure 298. humilis (Say)
Figure 299. difficilis Van Duzee
Figure 300. teximus Caldwell, new status; Uvalde County, Texas form
Figure 301. teximus Caldwell, new status; Davis Mountains, Texas form
Figure 302. eximus Caldwell
Figure 303. placitus Van Duzee
Figure 304. montanus Metcalf
Figure 305. texanus Metcalf
Figure 306. yavapanus Ball
Figure 307. uncatus Caldwell
Figure 308. forcipatus Caldwell
Figure 309. arizonensis, new species; holotype
Figure 310. pygmaeus Ball
Figure 311. altanus Ball
Figure 312. coconinus Ball
Figure 313. catus Caldwell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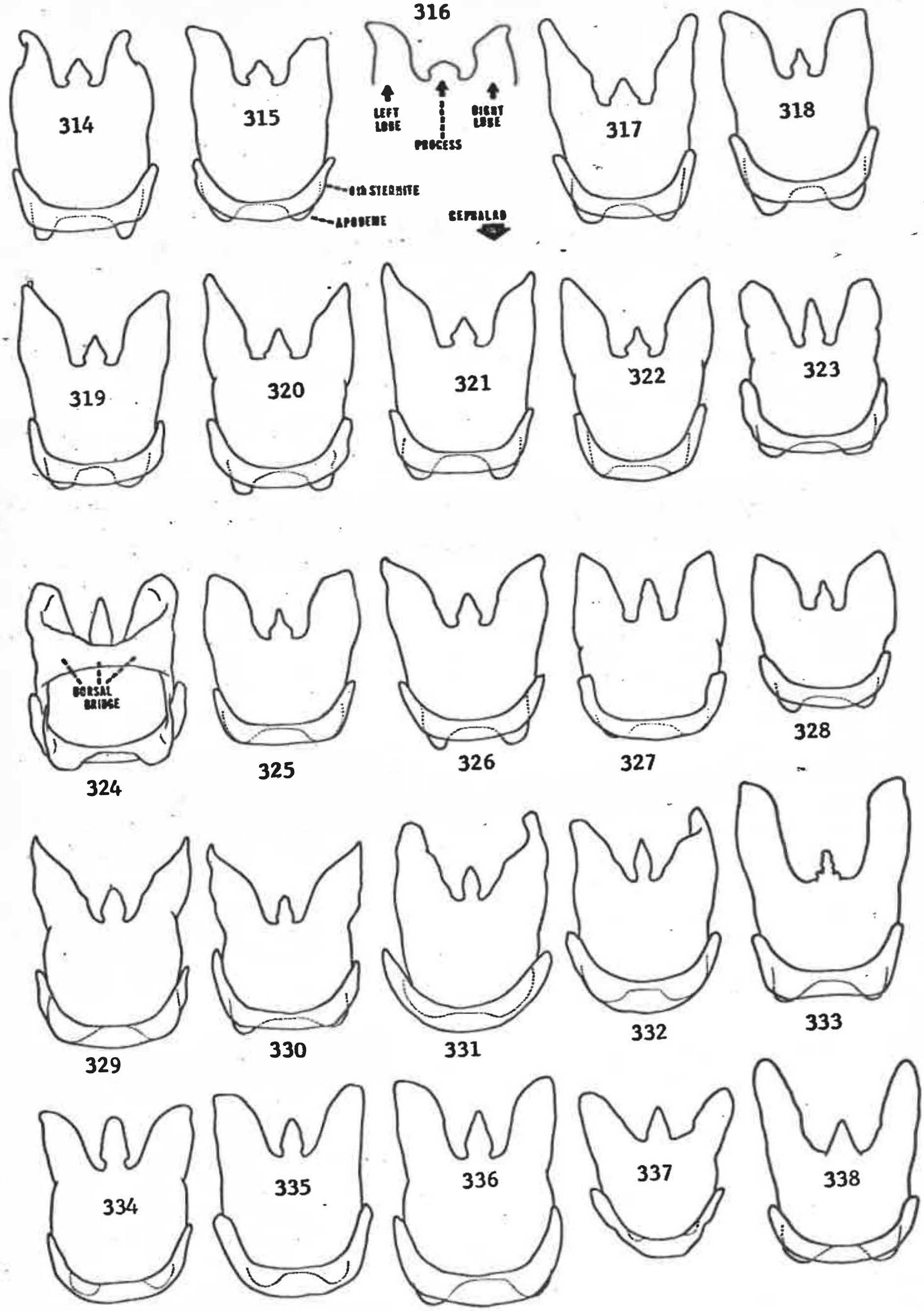
Species of _Oliarus_;
pygofer in ventral view, except as noted

Figure 314. _aridus_ Ball
Figure 315. _hesperius_ Van Duzee
Figure 316. _hesperius_ Van Duzee
Figure 317. _kieferi,_ new species; holotype
Figure 318. _pima_ Kirkaldy
Figure 319. _sonoitus_ Ball
Figure 320. _californicus_ Van Duzee
Figure 321. _knullorum,_ new species; holotype
Figure 322. _sementinus_ Ball
Figure 323. _canyonensis,_ new species; holotype
Figure 324. _canyonensis,_ new species; holotype (dorsal aspect)
Figure 325. _retentus_ Caldwell
Figure 326. _truncatus_ Van Duzee
Figure 327. _apache_ Ball
Figure 328. _papagonus_ Ball
Figure 329. _caldwelli,_ new species; holotype
Figure 330. _lobatus_ Caldwell
Figure 331. _habeckorum,_ new species; holotype
Figure 332. _cinnamomeus_ Provancher
Figure 333. _slossonae_ Van Duzee
Figure 334. _quinquelineatus_ (Say)
Figure 335. _vicarius_ (Walker); Jacksonville, Florida
Figure 336. _vicarius_ (Walker); Estero, Florida
Figure 337. _humilis_ (Say)
Figure 338. _difficilis_ Van Duzee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LEFT LOBE
PROCESS
RIGHT LOBE
8th STERNITE
APODEME
CEPHALAD
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DORSAL BRIDGE
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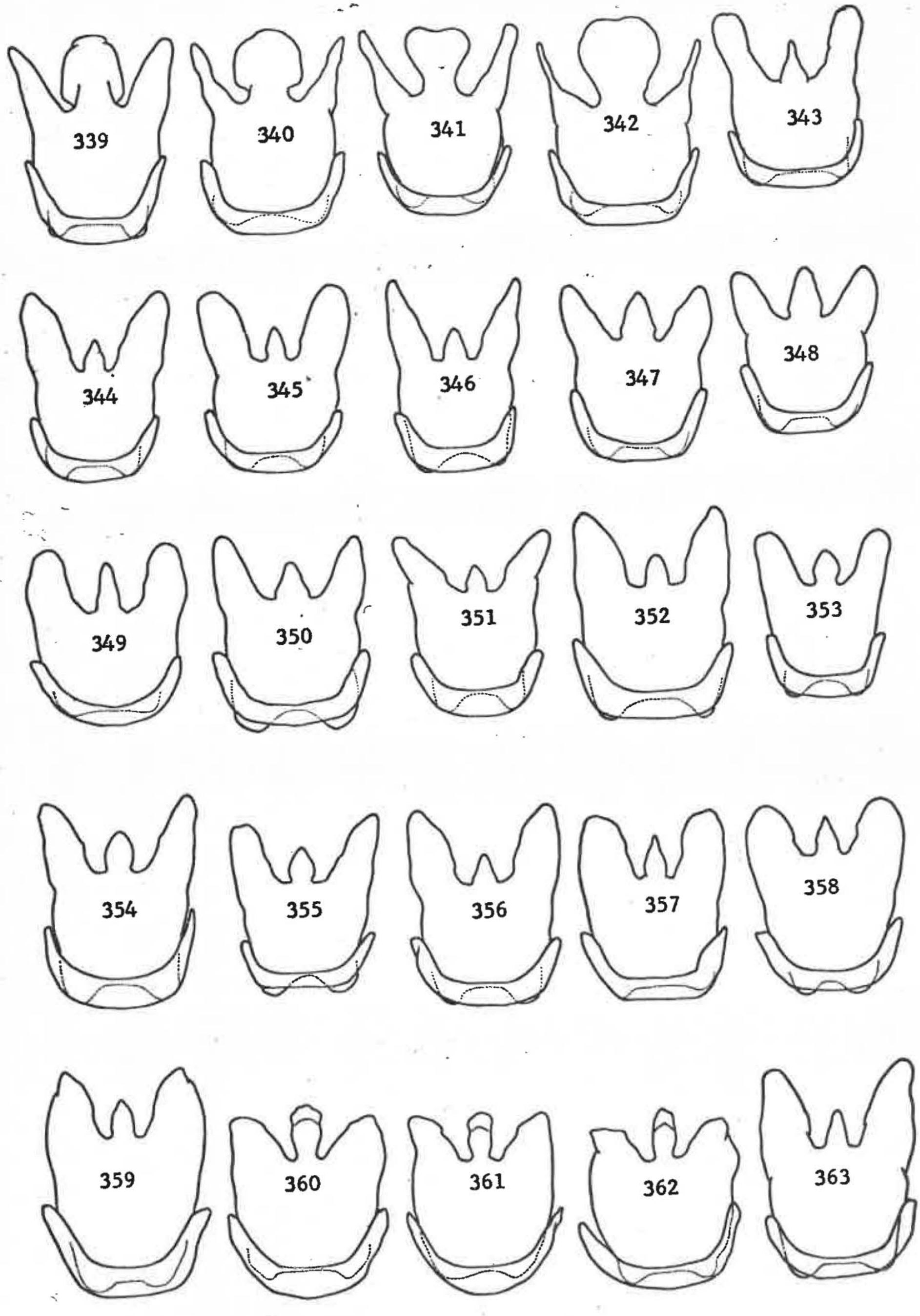
Species of *Oliarus*;
pygofer in ventral aspect

Figure 339. *teximus* Caldwell, new status
Figure 340. *eximus* Caldwell
Figure 341. *placitus* Van Duzee
Figure 342. *montanus* Metcalf
Figure 343. *texanus* Metcalf
Figure 344. *yavapanus* Ball
Figure 345. *uncatus* Caldwell
Figure 346. *forcipatus* Caldwell
Figure 347. *arizonensis*, new species; holotype
Figure 348. *arizonensis*, new species; paratype, La Osa River, Arizona
Figure 349. *pygmaeus* Ball
Figure 350. *altanus* Ball
Figure 351. *coconinus* Ball
Figure 352. *catus* Caldwell
Figure 353. *bispinus* Caldwell
Figure 354. *sablensis* Caldwell
Figure 355. *chuliotus* Ball
Figure 356. *ecologus* Caldwell
Figure 357. *complectus* Ball
Figure 358. *viequensis* Caldwell
Figure 359. *acicus* Caldwell
Figure 360. *exoptatus* Van Duzee
Figure 361. *beirnei*, new name
Figure 362. *fidus* Van Duzee
Figure 363. *altanatus* Caldwell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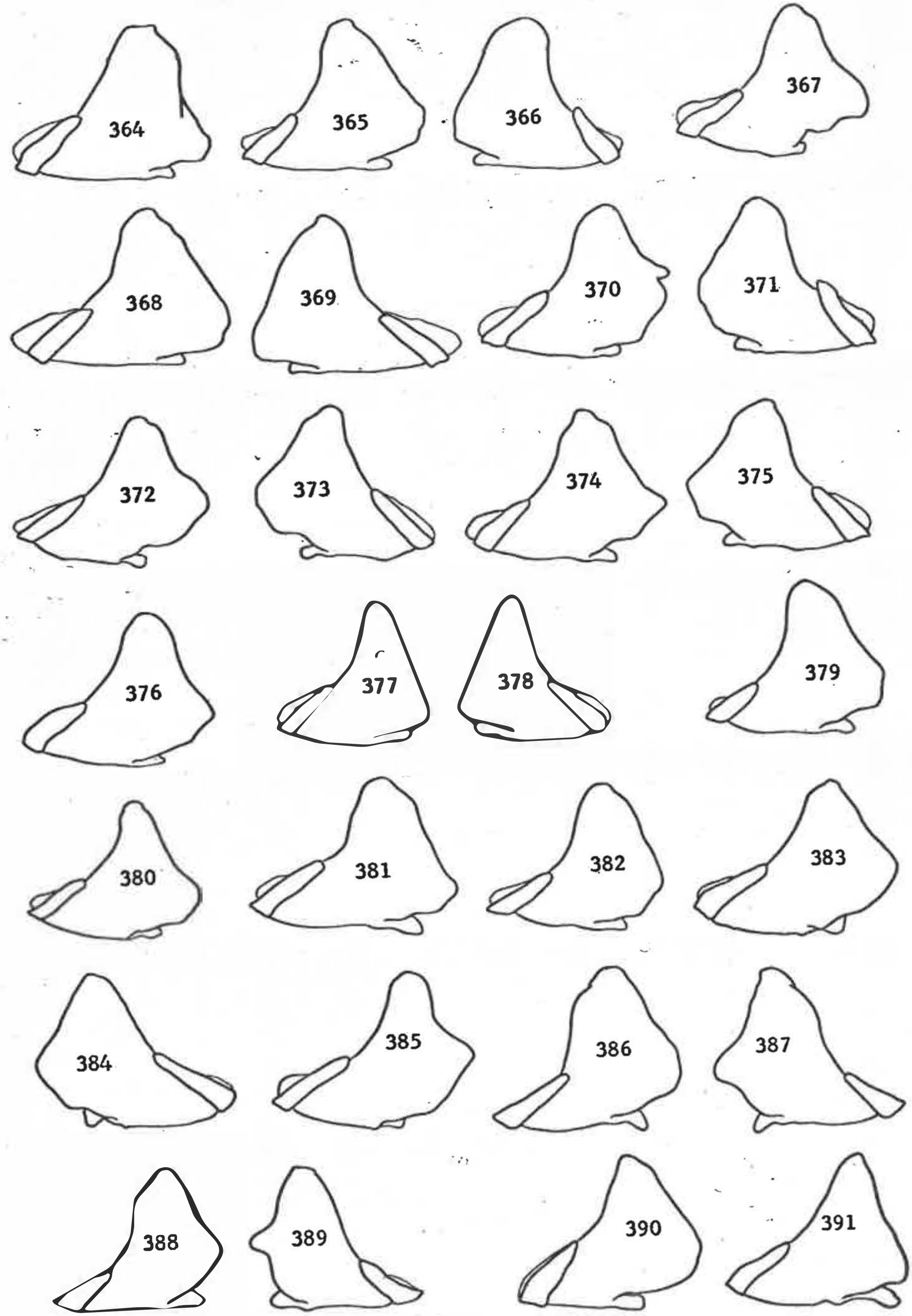
Species of *Oliarus*;
pygofer in lateral view

Figure 364. Left of *aridus* Ball
Figure 365. Left of *hesperius* Van Duzee
Figure 366. Right of *hesperius* Van Duzee
Figure 367. Left of *kieferi*, new species; holotype
Figure 368. Left of *pima* Kirkaldy
Figure 369. Right of *pima* Kirkaldy
Figure 370. Left of *sonoitus* Ball
Figure 371. Right of *sonoitus* Ball
Figure 372. Left of *californicus* Van Duzee
Figure 373. Right of *californicus* Van Duzee
Figure 374. Left of *knullorum*, new species; holotype
Figure 375. Right of *knullorum*, new species; holotype
Figure 376. Left of *sementinus* Ball
Figure 377. Left of *canyonensis*, new species; holotype
Figure 378. Right of *canyonensis*, new species; holotype
Figure 379. Left of *retentus* Caldwell
Figure 380. Left of *truncatus* Van Duzee
Figure 381. Left of *apache* Ball
Figure 382. Left of *papagonus* Ball
Figure 383. Left of *caldwelli*, new species; holotype
Figure 384. Right of *caldwelli*, new species; holotype
Figure 385. Left of *lobatus* Caldwell
Figure 386. Left of *habeckorum*, new species; holotype
Figure 387. Right of *habeckorum*, new species; holotype
Figure 388. Left of *cinnamomeus* Provancher
Figure 389. Right of *cinnamomeus* Provancher
Figure 390. Left of *slossonae* Van Duzee
Figure 391. Left of *quinquelineatus* (Say)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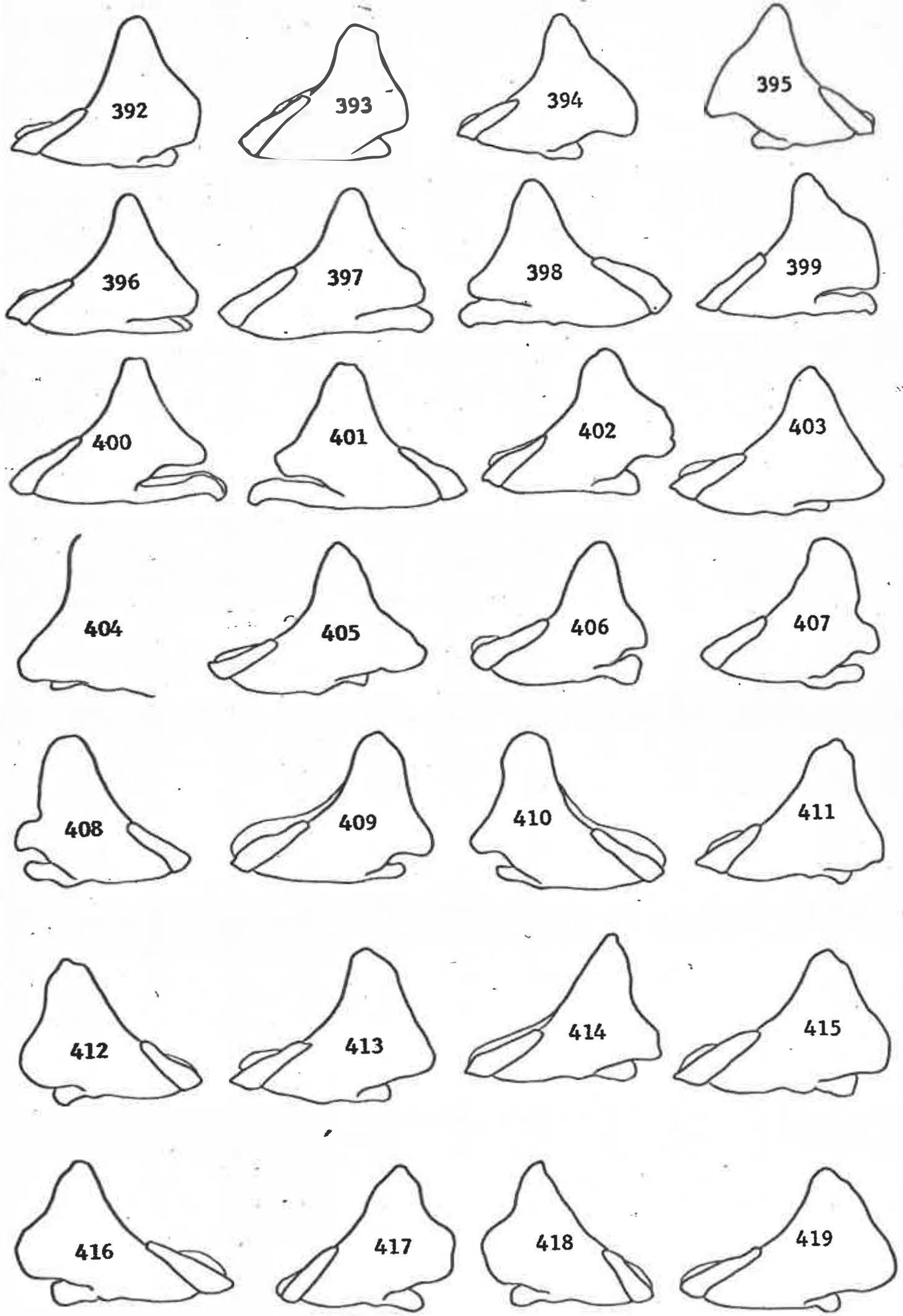
Species of *Oliarus*;
pygofer in lateral view

Figure 392. Left of vicarius (Walker)
Figure 393. Left of humilis (Say)
Figure 394. Left of difficilis Van Duzee
Figure 395. Right of difficilis Van Duzee
Figure 396. Left of teximus Caldwell
Figure 397. Left of eximus Caldwell
Figure 398. Right of eximus Caldwell
Figure 399. Left of placitus Van Duzee
Figure 400. Left of montanus Metcalf
Figure 401. Right of montanus Metcalf
Figure 402. Left of texanus Metcalf
Figure 403. Left of yavapanus Ball
Figure 404. Right of uncatus Caldwell
Figure 405. Left of forcipatus Caldwell
Figure 406. Left of arizonensis, new species; holotype
Figure 407. Left of pygmaeus Ball
Figure 408. Right of pygmaeus Ball
Figure 409. Left of altanus Ball
Figure 410. Right of altanus Ball
Figure 411. Left of coconinus Ball
Figure 412. Right of coconinus Ball
Figure 413. Left of catus Caldwell
Figure 414. Left of bispinus Caldwell
Figure 415. Left of sablensis Caldwell
Figure 416. Right of sablensis Caldwell
Figure 417. Left of chuliotus Ball
Figure 418. Right of chuliotus Ball
Figure 419. Left of ecologus Caldwell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Species of *Oliarus*;
anal segment in dorsal view

Figure 420. *aridus* Ball; atypical form

Figure 421. *aridus* Ball; typical form

Figure 422. *hesperius* Van Duzee

Figure 423. *kieferi*, new species; holotype

Figure 424. *pima* Kirkaldy

Figure 425. *sonoitus* Ball

Figure 426. *californicus* Van Duzee

Figure 427. *knullorum*, new species; holotype

Figure 428. *sementinus* Ball

Figure 429. *canyonensis*, new species; holotype

Figure 430. *retentus* Caldwell

Figure 431. *truncatus* Van Duzee

Figure 432. *apache* Ball

Figure 433. *papagonus* Ball

Figure 434. *caldwelli*, new species; holotype

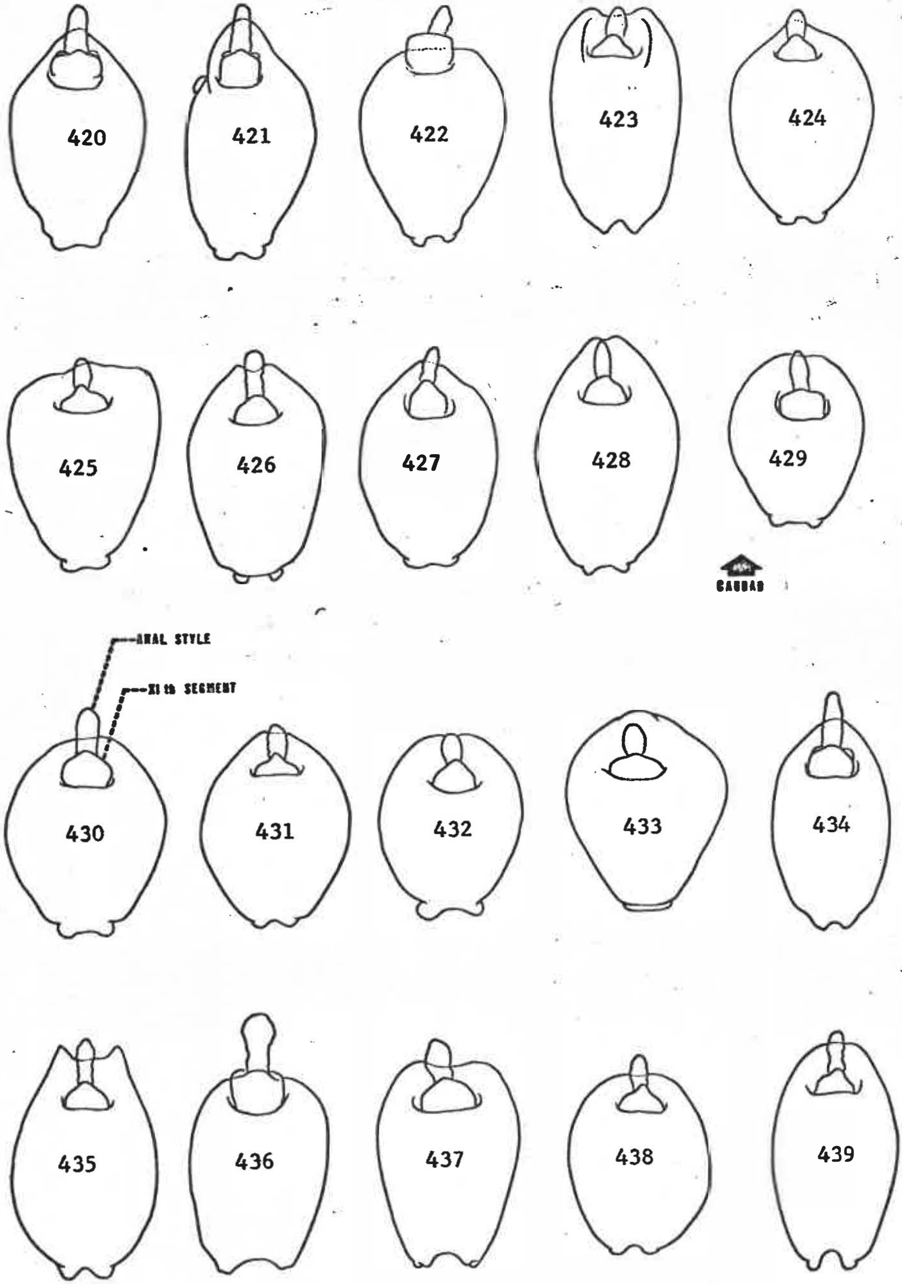
Figure 435. *lobatus* Caldwell

Figure 436. *habeckorum*, new species; holotype

Figure 437. *cinnamomeus* Provancher

Figure 438. *slossonae* Van Duzee

Figure 439. *quinquelineatus* (Say)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Species of *Oliarus*;
anal segment in dorsal view

Figure 440. *vicarius* (Walker)

Figure 441. *humilis* (Say)

Figure 442. *difficilis* Van Duzee

Figure 443. *teximus* Caldwell

Figure 444. *eximus* Caldwell

Figure 445. *placitus* Van Duzee

Figure 446. *montanus* Metcalf

Figure 447. *texanus* Metcalf

Figure 448. *yavapanus* Ball

Figure 449. *uncatus* Caldwell

Figure 450. *forcipatus* Caldwell

Figure 451. *arizonensis*, new species; holotype

Figure 452. *pygmaeus* Ball

Figure 453. *altanus* Ball

Figure 454. *coconinus* Ball

Figure 455. *catus* Caldwell

Figure 456. *bispinus* Caldwell

Figure 457. *sablensis* Caldwell

Figure 458. *chuliotus* Ball

Figure 459. *ecologus* Caldwell

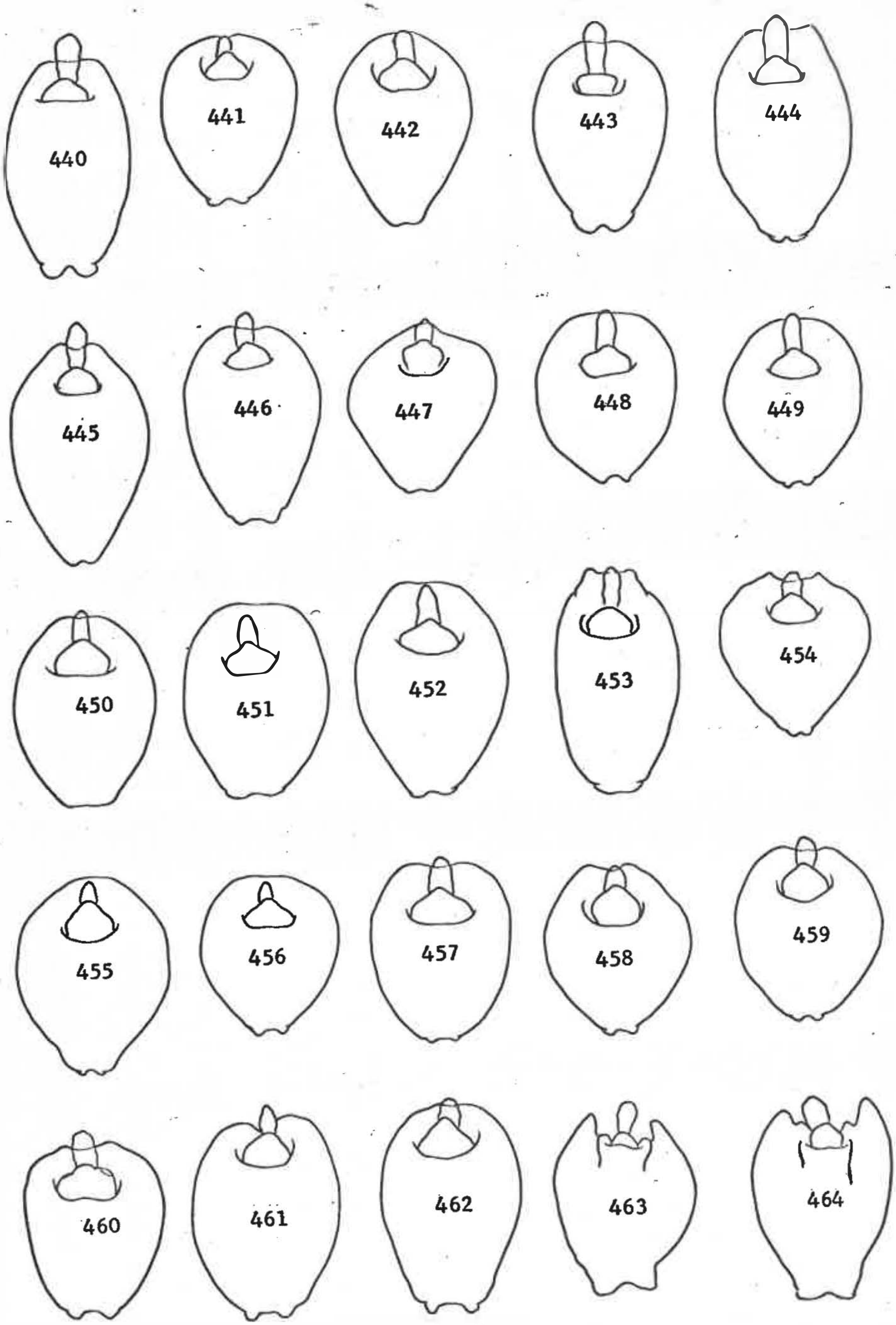
Figure 460. *complectus* Ball

Figure 461. *viequensis* Caldwell

Figure 462. *acicus* Caldwell

Figure 463. *exoptatus* Van Duzee

Figure 464. *beirnei* new name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Species of _Oliarus_;
anal segment in left lateral view, except as noted

Figure 465. _aridus_ Ball (right lateral of typical specimen)

Figure 466. _aridus_ Ball

Figure 467. _hesperius_ Van Duzee

Figure 468. _kieferi,_ new species; holotype

Figure 469. _pima_ Kirkaldy

Figure 470. _sonoitus_ Ball

Figure 471. _californicus_ Van Duzee

Figure 472. _knullorum,_ new species; holotype

Figure 473. _sementinus_ Ball

Figure 474. _canyonensis,_ new species; holotype

Figure 475. _retentus_ Caldwell

Figure 476. _truncatus_ Van Duzee

Figure 477. _apache_ Ball

Figure 478. _papagonus_ Ball

Figure 479. _caldwelli,_ new species; holotype

Figure 480. _lobatus_ Caldwell

Figure 481. _habeckorum,_ new species, holotype

Figure 482. _cinnamomeus_ Provancher

Figure 483. _slossonae_ Van Duzee

Figure 484. _quinquelineatus_ (Say)

Figure 485. _vicarius_ (Walker)

Figure 486. _humilis_ (Say)

Figure 487. _difficilis_ Van Duzee

Figure 488. _teximus_ Caldwell


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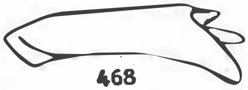
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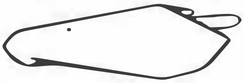
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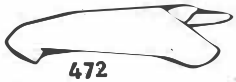
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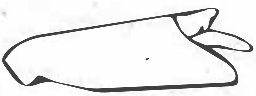
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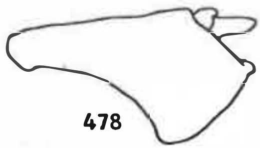
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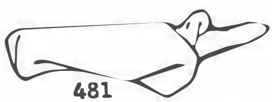
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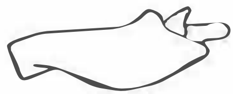
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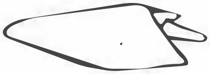
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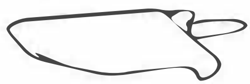
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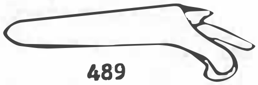
Species of *Oliarus*;
anal segment in left lateral view

Figure 489. *eximus* Caldwell
Figure 490. *placitus* Van Duzee
Figure 491. *montanus* Metcalf
Figure 492. *texanus* Metcalf
Figure 493. *yavapanus* Ball
Figure 494. *uncatus* Ball
Figure 495. *forcipatus* Caldwell
Figure 496. *arizonensis*, new species; holotype
Figure 497. *pygmaeus* Ball
Figure 498. *altanus* Ball
Figure 499. *coconinus* Ball
Figure 500. *catus* Caldwell
Figure 501. *bispinus* Caldwell
Figure 502. *sablensis* Caldwell
Figure 503. *chuliotus* Ball
Figure 504. *ecologus* Caldwell
Figure 505. *complectus* Ball
Figure 506. *viequensis* Caldwell
Figure 507. *acicus* Caldwell
Figure 508. *exoptatus* Van Duzee
Figure 509. *beirnei*, new name
Figure 510. *fidus* Van Duzee
Figure 511. *altanatus* Caldwell
Figure 512. *corvinus* Ball
Figure 513. *littoralis* Ball
Figure 514. *sylvaticus* Caldwell
Figure 515. *dondonius* Ball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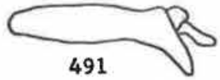
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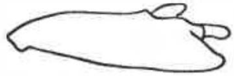
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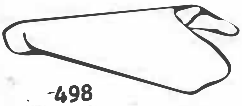
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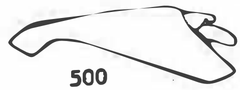
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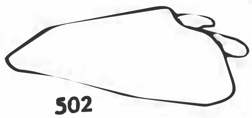
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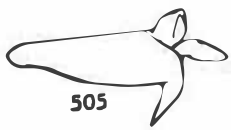
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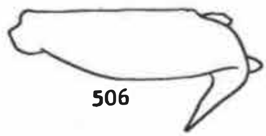
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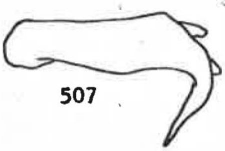
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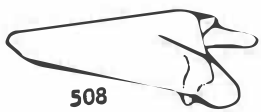
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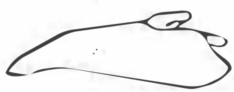
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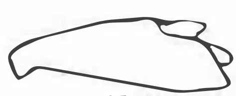
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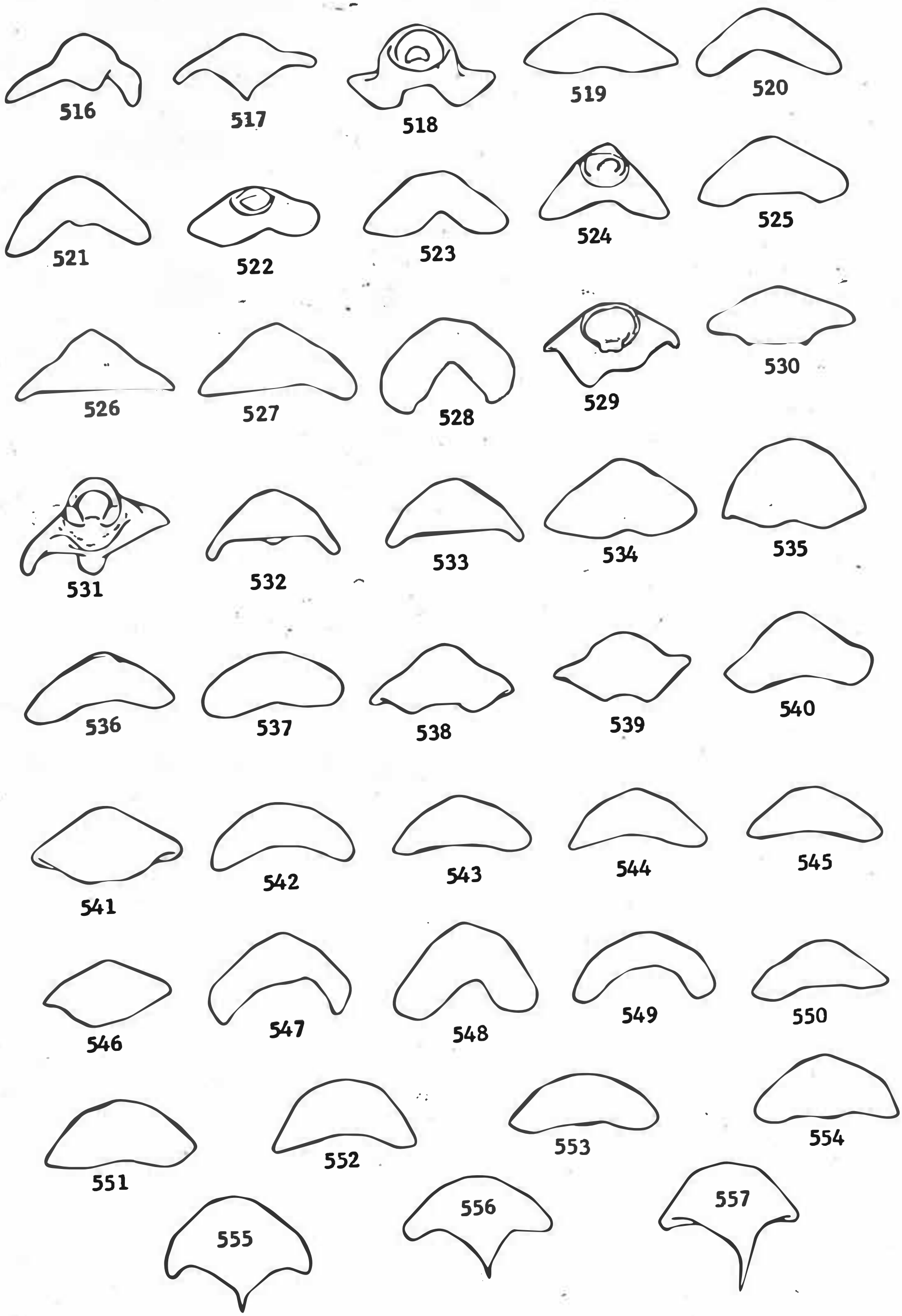
Species of *Oliarus*; anal segment in posterior aspect

Figure 516. aridus Ball (typical form)
Figure 517. hesperius Van Duzee
Figure 518. kieferi, new species; holotype
Figure 519. pima Kirkaldy
Figure 520. sonoitus Ball
Figure 521. californicus Van Duzee
Figure 522. knullorum, new species; holotype
Figure 523. sementinus Ball
Figure 524. canyonensis, new species; holotype
Figure 525. retentus Caldwell
Figure 526. truncatus Van Duzee
Figure 527. apache Ball
Figure 528. papagonus Ball
Figure 529. caldwelli, new species; holotype
Figure 530. lobatus Caldwell
Figure 531. habeckorum, new species; holotype
Figure 532. cinnamomeus Provancher
Figure 533. slossonae Van Duzee
Figure 534. quinquelineatus (Say)
Figure 535. vicarius (Walker)
Figure 536. humilis (Say)
Figure 537. difficilis Van Duzee
Figure 538. teximus Caldwell
Figure 539. eximus Caldwell
Figure 540. placitus Van Duzee
Figure 541. montanus Metcalf
Figure 542. texanus Metcalf
Figure 543. yavapanus Ball
Figure 544. uncatus Caldwell
Figure 545. forcipatus Caldwell
Figure 546. arizonensis, new species; paratype Tucson, Arizona
Figure 547. pygmaeus Ball
Figure 548. altanus Ball
Figure 549. coconinus Ball
Figure 550. catus Caldwell
Figure 551. bispinus Caldwell
Figure 552. sablensis Caldwell
Figure 553. chuliotus Ball
Figure 554. ecologus Caldwell
Figure 555. complectus Ball
Figure 556. viequensis Caldwell
Figure 557. acicus Caldwell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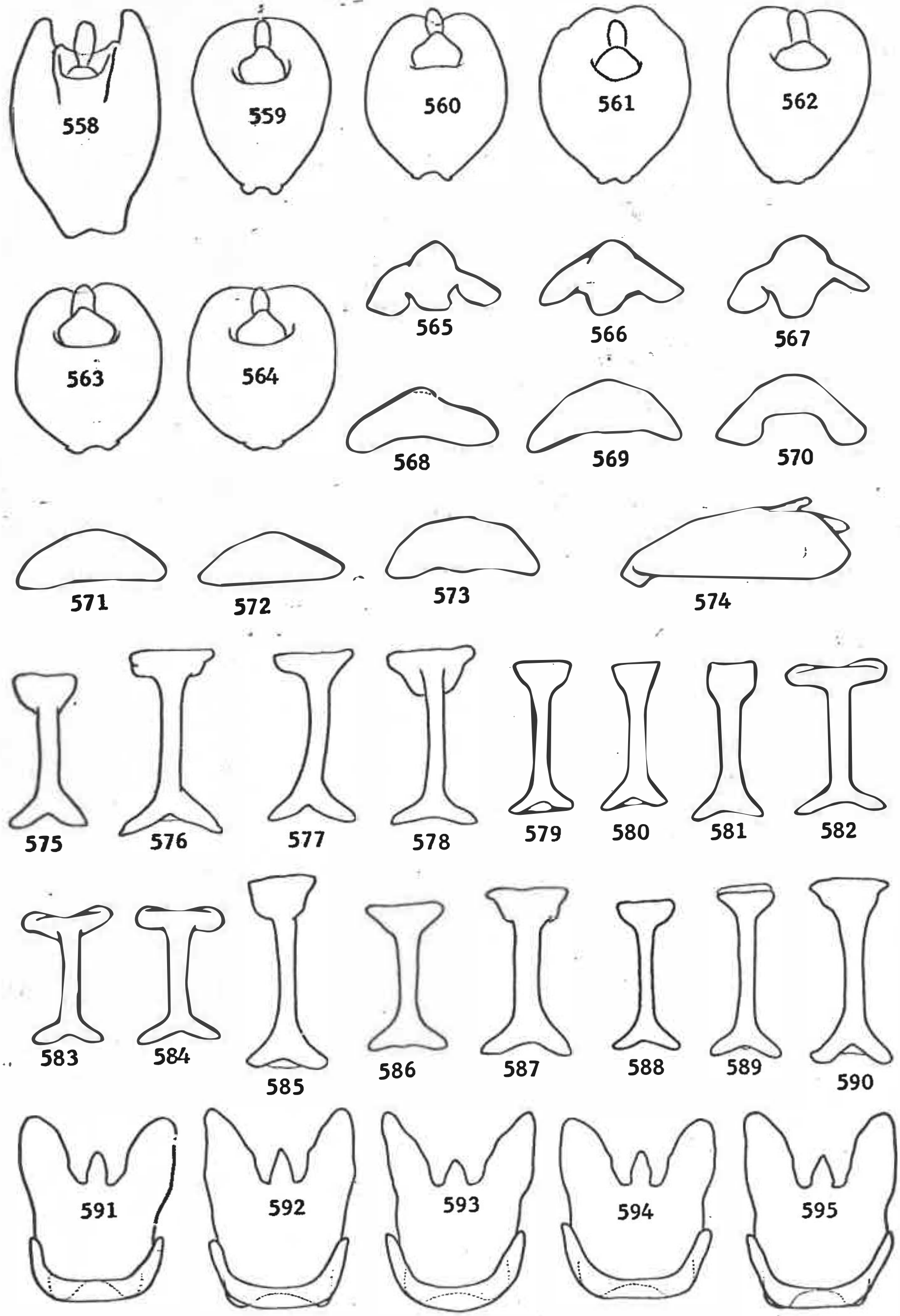
Species of *Oliarus*

Figure 558. Anal segment, dorsal view of *fidus* Van Duzee
Figure 559. Anal segment, dorsal view of *altanatus* Caldwell
Figure 560. Anal segment, dorsal view of *corvinus* Ball
Figure 561. Anal segment, dorsal view of *littoralis* Ball
Figure 562. Anal segment, dorsal view of *sylvaticus* Caldwell
Figure 563. Anal segment, dorsal view of *dondonius* Ball
Figure 564. Anal segment, dorsal view of *zyxus* Caldwell
Figure 565. Anal segment, posterior view of *exoptatus* Van Duzee
Figure 566. Anal segment, posterior view of *beirnei*, new name
Figure 567. Anal segment, posterior view of *fidus* Van Duzee
Figure 568. Anal segment, posterior view of *altanatus* Caldwell
Figure 569. Anal segment, posterior view of *corvinus* Ball
Figure 570. Anal segment, posterior view of *littoralis* Ball
Figure 571. Anal segment, posterior view of *sylvaticus* Caldwell
Figure 572. Anal segment, posterior view of *dondonius* Ball
Figure 573. Anal segment, posterior view of *zyxus* Caldwell
Figure 574. Anal segment, left lateral view of *zyxus* Caldwell
Figure 575. Connective, posterior view of *bispinus* Caldwell
Figure 576. Connective, posterior view of *sablensis* Caldwell
Figure 577. Connective, posterior view of *chuliotus* Ball
Figure 578. Connective, posterior view of *ecologus* Caldwell
Figure 579. Connective, posterior view of *complectus* Ball
Figure 580. Connective, posterior view of *viequensis* Caldwell
Figure 581. Connective, posterior view of *acicus* Caldwell
Figure 582. Connective, posterior view of *exoptatus* Van Duzee
Figure 583. Connective, posterior view of *beirnei*, new name
Figure 584. Connective, posterior view of *fidus* Van Duzee
Figure 585. Connective, posterior view of *altanatus* Caldwell
Figure 586. Connective, posterior view of *corvinus* Ball
Figure 587. Connective, posterior view of *littoralis* Ball
Figure 588. Connective, posterior view of *sylvaticus* Caldwell
Figure 589. Connective, posterior view of *dondonius* Ball
Figure 590. Connective, posterior view of *zyxus* Caldwell
Figure 591. Pygofer, ventral view of *corvinus* Ball
Figure 592. Pygofer, ventral view of *littoralis* Ball
Figure 593. Pygofer, ventral view of *sylvaticus* Caldwell
Figure 594. Pygofer, ventral view of *dondonius* Ball
Figure 595. Pygofer, ventral view of *zyxus* Caldwell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SUMMARY

The genus Oliarus in North America north of Mexico was studied with emphasis on the morphology of the male terminalia. The aedeagal complexes of 36 previously described species were illustrated for the first time. Six species proposed as new to science were described and illustrated. A change of status was proposed for one species, a new name given to another species, lectotypes were designated for two species, and three nominal species were relegated to synonymy. Fifty-one species in the study area were considered as valid, with each species receiving attention as to important features of the external morphology, male terminalia, diagnosis from similar species, location of type material, morphological variation, seasonal and geographical distribution, and other biological information when available. Materials and methods used, remarks on relationships, and a key to the species, based on male terminalia, were also included.

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