BULLETIN OF THE CALIFORNIA INSECT SURVEY
VOLUME 6, NO. 4

THE SIRACID WOOD WASPS OF CALIFORNIA

(Hymenoptera: Symphyta)

BY

WILLIS HOW W. MIDDLEKAUFF
(Department of Entomology and Parasitology, University of California, Berkeley)

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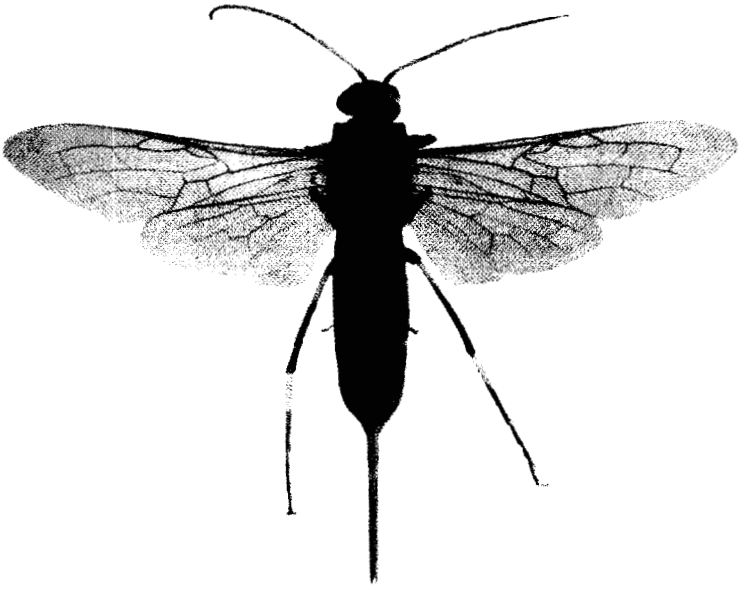

Urocerus californicus Norton, female.

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THE SIRICID WOOD WASPS OF CALIFORNIA

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BY

WOODROW W. MIDDLEKAUFF

INTRODUCTION

The siricid wood wasps are fairly large, cylindrical insects, usually 20 mm. or more in length with the head, thorax, and abdomen of equal width. The antennae are long and filiform, with 14 to 30 segments. The tegulae are minute. In the female the last segment of the abdomen bears a hornlike projection called the cornus (fig. 8), whose configuration is useful for taxonomic purposes. This distinctive structure also gives them the common name of horntails. The ovipositor is exserted and in some species may be quite long, even exceeding the body length. Males are normally smaller than the females, with flattened tibiae and tarsi and with the last abdominal sternite ending in a sharp point. The size of adult siricids is quite variable and may vary to twice the size in the same species. The wood-boring larvae are whitish cream or yellow, usually cylindrical, weakly S-shaped with only vestigial thoracic legs and with a small horny spine at the posterior end. Abdominal prolegs are absent.

In California siricids are not as a rule considered to be primary enemies of sound timber since usually they do not attack healthy standing trees. They will, however, readily attack fire-damaged or otherwise injured or dying trees and ones recently felled. Female *Sirex areolatus* have even been reported as attacking recently sawed redwood lumber. The larval and adult borings reduce the quality of the lumber causing it to be downgraded. Adults may cause considerable damage while emerging from infested timbers in homes by boring through plaster walls, hardwood floors, and carpeting. Their powerful mandibles can even cut through lead sheathing.

These insects are widely disseminated by shipments of infested lumber or timber, and the adults may not emerge until several years have elapsed. Movement of this lumber and timber tends to complicate an understanding of the normal distribution pattern of the species.

The Nearctic species in the family were monographed by Bradley (1913). Since that date the description of one new North American species in the genus *Sirex* has been published (Middlekauff, 1948). The excellent papers by Benson (1943, 1951) in which he gives keys to world genera and European species prompted me to study more thoroughly the systematics and distribution of the siricid fauna of California.

The family Siricidae in California is composed of two subfamilies: the Siricinae containing the genera *Sirex*, *Urocerus*, and *Xeris*, and the Tremicinae containing the single genus *Tremex*. To date, 13 species and subspecies in these genera are definitely known from the state. *Sirex nigricornis* Fab. is doubtfully recorded from California (Norton, 1869), and subsequent collections have failed to confirm it as being present in our fauna.

BIOLOGY

Although a considerable amount of study has recently been done by British and New Zealand workers on various biological and life history phases of several species of the Siricidae, little is known about our North American spe-

cies. Most of our biological information consists of scattered and fragmentary notes on ovipositing or on emerged specimens. Except for the very fine and detailed work by several British workers on the life history and parasites of the introduced American species *Sirex cyaneus* Fabricius, not one single American siricid has been adequately studied.

Adults fly mostly in bright sunshine, and females are usually more abundant than males. Males are reputed to resort to the treetops or high ground where pairing takes place, and this may in part account for their relative scarcity in collections. That males are not yet well known is probably due to this lack of material for study rather than through any intrinsic difficulties in distinguishing them. The genitalia seem of slight and doubtful significance for purposes of taxonomic distinction.

Females usually oviposit in trees weakened or dying as a result of fire, disease, or other injury. Occasionally they select a tree which to all appearance is still healthy. Ovipositing females insert their ovipositors deeply into the wood and lay their eggs. Sometimes they are unable to withdraw their ovipositors and die in this position.

The larvae bore into the trunk of the tree, making perfectly cylindrical holes in the wood and pack the frass from their borings in the tunnels behind them. *Tremex* may complete larval growth and pupate within a year, but no definite data are available. According to Hanson (1939), the life cycle of *Sirex cyaneus* normally extends for a period of three years from egg to adult, but development may be retarded and the adult insects may not emerge from the timber until several additional years have elapsed. A number of generations may be present in a single log at any one time, and this greatly complicates understanding the composition of the population.

Horntails are of additional interest to biologists because of the symbiotic relationship of *Sirex*, *Urocerus*, and *Tremex* with certain wood-destroying fungi. The fungi are commonly found apart from the siricids but with the exceptions of *Xeris* (Francke-Grosmann, 1939) all female wood wasps examined have had associated fungi. No fungi or fungal sacs have been found in adult males.

In the female, the fungus is contained in a pair of small invaginated intersegmental fungal sacs which project into the body cavity at the basal end of the ovipositor, opening into the channel of the ovipositor and not into the oviduct. The egg becomes infected as it is laid, and the wood-destroying fungus penetrates the wood surrounding the larva as it feeds. Experiments have demonstrated that larvae can live for at least three months on a pure culture of the fungi. It has been theorized that the larvae may be more or less mycetophagous and may not need cellulose for their subsistance. Parkin (1942) found the fungi associated with the larvae and confirmed previous work which showed that the adult female becomes infected in the pupal chamber after shedding the pupal skin before emergence.

A number of natural enemies prey upon the horntails; of these, various Hymenoptera are most important. Members of the cynipid genus *Ibalia* (fig. 18) and the ichneumonid genera *Rhyssa* and *Megarhyssa* (fig. 19) parasitize the larvae of Siricidae.

The life cycle of *Ibalia* requires at least two years. It oviposits in the young siricid larva just before or more rarely just after it hatches, utilizing the oviposition bores of the *Sirex* for this purpose. The parasite larva is endoparasitic. Parasitized host larvae confine their borings largely to the outer parts of the tree trunk and usually make their final cell just under and approximately parallel to the surface.

Females of *Rhyssa* and *Megarhyssa* lay their eggs in the burrow of, and near to, the almost fully grown host larva or the pupa by piercing the solid wood with their ovipositors. Feeding by the ichneumonid parasite is entirely ectoparasitic and takes only a few weeks, during which the host larva may burrow a little farther. The winter is passed by *Rhyssa* or *Megarhyssa* as a resting larva. Pupation takes place in the spring, and the whole life cycle normally occupies one year.

Woodpeckers, contrary to popular belief, consume few if any siricid larvae. Beal (1911), in his paper on the food of North American woodpeckers, fails to mention larvae in their diet.

As in previous publications in this series, the locations of the specimens from which the records have been taken are reported. The following abbreviations have been used for institutional and other collections:

California Insect Survey, University of California, Berkeley (C.I.S.)
California Academy of Sciences (C.A.S.)
University of California, College of Agri-

culture, Davis (U.C.D.)
University of Oregon (U.O.)
California State Department of Agriculture, Sacramento (C.S.D.A.)
California Forest and Range Experiment Station, Berkeley (C.F.R.E.S.)[1]
Los Angeles County Museum (L.A.C.M.)
San Jose State College (S.J.S.C.)
University of Idaho (U.I.)

I am indebted to the authorities of these institutions, as well as to individuals whose records are separately reported, for the privilege of studying the specimens which have formed the basis of this paper, and to Mrs. Celeste Green, Scientific Illustrator, for the drawings which accompany this study.

Key to the Subfamilies and Genera of California Siricidae

1. Antennae short, slightly swollen in middle, at most as long as head and thorax combined (fig. 4); cross veins Cu_1 and 2 r-m absent; cell 2A of forewing with base of 3A present (fig. 3); labial palpi 2-segmented. Larvae bore in angiosperm trees (Tremicinae) . . . . . *Tremex columba* (p. 70)

   Antennae long, filiform, much longer than head and thorax combined (fig. 2); cross vein 2 r-m present; cell 2A with base of 3A absent (fig. 1); labial palpi 3-segmented. Larvae bore in conifers (Siricinae) . . 2

2. Head without pale areas above and behind the eyes; cornus of female usually not constricted in middle (except slightly in *Sirex longicauda*) (fig. 8); forewing with at least basal half of Cu_1 present . . . . . *Sirex* (p. 61)

   Dorsal surface of head entirely pale or with at least a pale spot behind each eye; cornus of female constricted in middle (fig. 15); forewing with vein Cu_1 usually completely atrophied 3

3. Head with a lateral carina behind the eye (fig. 2); ovipositor about half again as long as forewing (except *Xeris macgillivrayi*); hindwing without a closed anal cell (fig. 3); eye almost round (fig. 16); hind tibia with only one apical spur . . . . . *Xeris* (p. 68)

   Head without a lateral carina; ovipositor at most scarcely longer than forewing; hind wing usually with a closed anal cell (fig. 5); eye distinctly longer than broad (fig. 17); hind tibia with two apical spurs. . . . . *Urocerus* (p. 66)

Genus *Sirex* Linnaeus, 1761

Sirex is Holarctic in distribution with about 20 species described, 9 of which occur in North America; all but 3 of these are reported from California. The females oviposit in the trunks of various species of conifers in the genera *Sequoia, Cupressus, Libocedrus, Pseudotsuga, Pinus,* and *Abies,* and the larvae are wood borers. Species in the genus *Sirex* lack a pale area behind the eyes dorsally; normally the cornus is not constricted; the forewing has at least the basal half of vein Cu_1 present. The California species may be separated by means of the following key.

Key to the California Species of *Sirex*

1. Females; ovipositor present 2
   Males[1]; ovipositor absent (some species not separable with any degree of certainty) 7

Females

2. Ovipositor as long as the forewing, usually longer 3
   Ovipositor shorter than forewing 4
3. Legs with tibiae and tarsi red; cornus as in fig. 8 . . . . . *longicauda* (p. 65)
   Legs entirely black or blue-black; cornus variable, slightly more triangular (fig. 13) . . . . . *areolatus* (p. 62)
4. Abdomen, except for basal segments, reddish brown; forewing with a transverse fuscous band beneath the stigma and a fuscous apical margin; cornus mildly shouldered (fig. 12); two basal abdominal segments blue-black . . . . . *behrensii* (p. 63)
   Abdomen entirely bluish black 5
5. Legs except coxae and trochanters reddish brown; wings usually nearly hyaline except for infuscated apical margin; cornus not shouldered (fig. 10). *cyaneus* (p. 64)
   Legs black or dark reddish blue 6
6. Forewing infuscated on apical margin and

[1]The males of *californicus, longicauda,* and *obesus* are unknown.

[1]Since going to press the name of this branch of the U.S.D.A. has been changed to Pacific Southwest Forest and Range Experiment Station.

across middle; cornus seen from above triangular or shouldered. *californicus* (p. 63)

Wings uniformly dark violaceous; cornus distinctly shouldered (fig. 9); tarsal pads ivory white in color, contrasting sharply with the dark legs . . . . *obesus* (p. 65)

Males

7. Head, thorax, legs, antennae, basal and apical abdominal segments metallic blue-black; abdominal segments III-VII yellowish orange . . . . . *areolatus* (p. 62)

Head and thorax black or blue-black; legs not as above; antennae blue-black or basally reddish 8

8. Wings hyaline, a little smoky at the tip; fore- and midlegs except their coxae and trochanters reddish brown; basal segments of antennae red; abdomen except basal segments reddish . . . . . *behrensii* (p. 63)

Wings slightly yellow with a faint smoky band around the margins; posterior legs bluish black except the distal segment of the trochanter; fore- and midlegs beyond trochanters mostly reddish brown; thorax metallic blue or greenish; base of antennae reddish brown or black. *cyaneus* (p. 64)

Sirex areolatus (Cresson)
(Western horntail)

Urocerus areolatus Cresson, 1867. ♀ Trans. Amer. Ent. Soc., 1:375. Type ♀, New Mexico.

Sirex gracilis Westwood, 1874. Thesaurus Ent. Oxon., 114. ♀.

Urocerus caeruleus Cresson, 1880. Trans. Amer. Ent. Soc., 8:34. ♀.

Sirex apicalis Kirby, 1882. List Hym. Brit. Mus., 1:377. ♂.

Geographic range: Arizona, British Columbia, California, Colorado, New Mexico, Oregon, Washington.

California records:

Alameda Co.: Berkeley ♂, X-10-25 (C.I.S.): ♂, IX-23-15, *Cupressus macrocarpa* (C.A.S.); ♀, IX-1933 (E. C. Zimmerman, C.A.S.); 3 ♀, XII-2-22 (S. E. Flanders, C.I.S.); ♀, X-16-34 (C.I.S.); Leona Hts., ♀, X-24-20 (E. P. Van Duzee, C.A.S.); Oakland, ♀, X-23-53 (J. V. Lonergan, C.S.D.A.).

Contra Costa Co.: Pleasant Hill, ♀, IX-15-57 (T. A. Smith, C.I.S.).

Humboldt Co.: Eureka, ♂, ♀, IX-29-49 (C.I.S.); ♂, 12-9-39 (J. Torio, C.S.D.A.); Arcata, ♀, X-18-34 (W. E. Peacock, C.S.D.A.).

Marin Co.: Alpine Dam, ♀, IX-1935 (Edward Ross, C.A.S):, Muir Woods, ♀, XI-15-51 (Alice and J. G. Edwards, Donald Burdick).

Monterey Co.: Carmel, ♀, IX-7-30 (L. S. Slevin, C.A.S.); Monterey, ♀, XI-19-47, redwood (W. K. Dayton, W.W.M.); 4 ♀, XI-18 to 19-47, redwood (W. K. Dayton, C.I.S.).

Orange Co.: Anaheim, ♀, IX-1929 (L.A. C.M.)

Sacramento Co.: N. Sacramento, ♂, VI-25-56 (Miller, C.S.D.A.).

San Francisco Co.: Cliff House Beach, ♀, XI-26-22 (C. L. Fox, C.A.S.); San Francisco, ♀, X-7-28 (E. Walther, C.A.S.); ♀, X-1-09 (F. X. Blaisdell, C.A.S.); ♂, IX-22-08 (F. X. Williams, C.A.S.); ♀, VIII-10-09 (F. X. Williams, C.A.S.); ♂, X-5-26 (E. Walther, C.A.S.); ♂, X-1-25 (F. M. Woods, C.A.S.).

San Mateo Co.: Palo Alto, 10 ♂, IX-8 to XI-9-32, *Cupressus macrocarpa* (C.I.S.) 7 ♀, IX-8 to 25-32, *Cupressus macrocarpa* (C.I.S.); San Mateo, 8 ♀, X-18 to 25-25 (B. H. Murray, C.A.S.).

Santa Clara Co.: Los Gatos, ♂, X-19-16 (H. E. Burke, C.F.R.E.S.); ♂, IX-19-17 (F. B. Herbert); Palo Alto, ♀, IX-15-30, Monterey cypress (H. E. Burke, C.F.R.E.S.); 52 ♂, 20 ♀, IX to X-1932, Monterey cypress (H. E. Burke, C.F.R.E.S.). San Jose, ♀, X-30-53, in house (J. Wirth, Donald Burdick).

Santa Cruz Co.: ♂, X-5-20 (E. A. Dodge, (C.A.S.); Big Basin, ♀, VII-18-46 (Don Meadows, L.A.C.M.); Santa Cruz, ♂, X-1923 (E. A. Dodge, C.A.S.); ♀, XI-9-20 (E. P. Van Duzee, C.A.S.); ♀, (C. Fuchs, C.A.S.).

Sierra Co.: E. of Sierra Buttes near Salmon Cr., ♂, X-23-54 (C. Worthington, Donald Burdick).

Sonoma Co.: Mesa Grande, 2 ♂, VII-17-08 (F. E. Blaisdell, C.A.S.); ♂, ♀, X-1907, ♀ ovip. in redwood (Baumberger, C.A.S.).

Tulare Co.: Paradise Creek, ♀, IX-19-30, *Libocedrus decurrens* (J. M. Miller, C.F.R.E.S.); Sequoia Nat'l. Park, ♂, IX-8-18, *Pinus lambertiana* (R. D. Hartman, C.F.R.E.S.).

Yuba Co.: Marysville, ♂, XI-1-34 (Crane, C.S.D.A.).

Hosts: Specimens have been reared from, or collected on, the following conifers: *Sequoia sempervirens*, coast redwood; *Cupressus macrocarpa*, Monterey cypress; *Pinus contorta*, lodgepole pine; *Pinus Jeffreyi*, Jeffrey pine; *Pinus lambertiana*, sugar pine; *Pinus radiata*, Monterey pine; *Libocedrus decurrens*, incense cedar; *Pseudotsuga taxifolia*, douglas fir; and on cedar. This species commonly attacks the coast redwood, cypress, and cedars and is found less frequently on pines.

Parasite: The parasite *Ibalia ensiger* was reared by Flanders from Berkeley specimens, XII-2-22.

Discussion:

In California this siricid is predominantly coastal in distribution. The steel blue body and legs and the long ovipositor, which is as long as the forewing, distinguish the female of this species. Our only other *Sirex* with a long ovipositor is *S. longicauda* Middlekauff which has the tibiae and tarsi red rather than bluish-black. The cornus is fairly uniform in shape but may, in some species, be slightly more triangular than shown in figure 13. Several females from Palo Alto, reared from Monterey cypress, are extremely small, not exceeding three-quarters of an inch from head to tip of ovipositor. This phenomenon of size variation is rather common in the Siricidae.

Essig (1926) reports females ovipositing in cured redwood lumber in the yards of Humbolt and Mendocino counties in California.

Sirex behrensii (Cresson)

Urocerus behrensii Cresson, 1880, Trans. Amer. Ent. Soc., 8:35. Type ♀, California.

Geographic range: California, Nevada, Washington.

California records:

Alameda Co.: Berkeley, ♀, IV-29-26 (E. C. Van Dyke, C.A.S.); XI-25-22, ovipositing in dead Monterey cypress, (S. E. Flanders, C.I.S.); ♂, X-20-15, (E. P. Van Duzee, C.I.S.); Livermore, ♀, X-1909 (C.A.S).

Madera Co.: Bass Lake, ♀, X-12-34, reared from sugar pine (C.I.S.); ♀, X-21-34 (C.I.S.); Oakhurst, 2 ♂, 2 ♀, XI-1955, *Pinus ponderosa* (C. B. Eaton, W.W.M.).

Mariposa Co.: Yosemite Valley, ♂ V-23-42 (C.I.S.); ♀, VI-1933 (C.I.S.).

Modoc Co.: Badger Township, ♀, X-16-37 (K. A. Salman, C.F.R.E.S.); Crowder Flat, 2 ♀, IX-1-27, *Pinus ponderosa* (F. P. Keen, C.F.R.E.S.).

San Diego Co.: Mt. Laguna, 2 ♀, XI-26-40, *Pinus Jeffreyi* (D. DeLeon, C.F.R.E.S.); 1 ♂, 2 ♀, X-27-41, *Pinus Jeffreyi* (D. DeLeon, C.F.R.E.S).

Santa Clara Co.: ♀, 1928 (C. D. Duncan, S.J.S.C.); Santa Clara ♀, X-20-31 (Forest Smith, S.J.S.C.).

Santa Cruz Co.: Santa Cruz, 2 ♀ (J. P. Strohbeen, C.A.S.).

Sonoma Co.: Santa Rosa, 5 ♀, XI-7-30, Japanese pine (H. E. Burke, C.F.R.E.S.); 6 ♀, XI-2-30, Monterey pine (S. Lockwood, C.S.D.A.).

Stanislaus Co.: Ceres, ♀, V-29-27 (D. Davis, C.A.S.).

Hosts: Specimens have been reared from, or collected on, the following conifers: *Pinus Jeffreyi*, Jeffrey pine; *Pinus lambertiana*, sugar pine; *P. ponderosa*, yellow pine; *P. radiata*, Monterey pine; *Cupressus macrocarpa*, Monterey cypress; and Japanese pine.

Parasite: A log of *Pinus ponderosa* from Oakhurst produced a number of *S. behrensii* as well as two female specimens of *Ibalia ensiger* Nort.

Discussion:

In spite of the fact that this species has not yet been recorded from Oregon, it is reasonable to assume that it will be taken there eventually. It has been collected both north and south of Oregon, and suitable hosts occur extensively in the state.

The reddish brown abdomen beyond segment II and the shape of the cornus (fig. 12) will serve to distinguish most of the females of this species. Several females have been seen with considerable black on the sides of the abdomen.

Sirex californicus (Ashmead)

Paururus californicus Ashmead, 1904, Canad. Ent., 36:64. Type ♀, California.

Geographic range: British Columbia, California, New Mexico, Oregon, Washington.

California records:

Alameda Co.: Berkeley, ♀, X-2-25, Monterey pine (E. C. Van Dyke, C.A.S.).

El Dorado Co.: Meyers Station, ♀, IX-21-16, *Pinus Jeffreyi* (F. B. Herbert, C.F.R.E.S.);

♀, VIII-31-15, *Pinus murrayana* (F. B. Herbert, C.F.R.E.S.); 2 ♀, IX-2-15, *Pinus murrayana* (F. B. Herbert, C.F.R.E.S.).

Inyo Co.: Parcher's Camp, Bishop Cr., ♀, IX-10-39 (L.A.C.M.).

Lassen Co.: Facht, ♀, VII-20-21 (J. O. Martin, C.A.S.).

Modoc Co.: Warner Mts., Davis Creek, 5,600-6,000′ elev., 3 ♀, VII-7 to 28-22 (A. W. Lindsey, C.A.S.); Crowder Flat, 2 ♀, IX-1-27, *Pinus ponderosa* (F. P. Keen, C.F.R.E.S.).

Plumas Co.: Quincy, 4 mi. W., ♀, VII-7-49 (W. H. Wade, C.I.S.).

San Bernadino Co.: Swartout Valley, ♀, IX-23-23, *Pinus Jeffreyi* (H. E. Burke, C.F.R.E.S.).

Tulare Co.: Camp Nelson, 4,700′ elev., 2 ♀, IX-18-14 (R. L. Beardsley, C.A.S.).

Tuolumne Co.: Pinecrest, 3 ♀, X-10 to 16-33 (R. P. Allen, C.A.S.); Tenaya Lake, ♀, VIII-20-17, *Pinus murrayana* (J. E. Patterson, C.F.R.E.S.); Yosemite, ♀, VIII-1933 (W. G. Scott, C.I.S.).

Hosts: Specimens have been reared from, or collected on, the following conifers: *Pinus Jeffreyi*, Jeffery pine; *Pinus murrayana* (= *contorta*), lodgepole pine; *Pinus ponderosa*; yellow pine; *Cupressus macrocarpa*, Monterey cypress; *Pseudotsuga menziesii*, Douglas fir.

Discussion:

This fairly common species is similar to the less abundant *obesus* in having the body and appendages dark blue and the ovipositor short. It differs from *obesus* in having an infuscated band around the apical margin of the wings and one across the wing beneath the stigma. The basal and central areas of the wings are nearly hyaline. The male is unknown.

Sirex cyaneus Fabricius

Sirex cyaneus Fabricius, 1781. Species Insectorum, 1:419. Type ♀, North America.

Sirex duplex Shuckard, 1837. Mag. Nat. Hist. (n.s.), 1:630. ♂, ♀.

Urocerus nitidus Harris, 1841. Rpt. Ins. Mass., Injurious to veg., p. 391. ♀.

Sirex varipes Walker, 1866. *In* Lord, Naturalist in Vancouver Is. and B.C., 2:342. ♀.

Sirex hirsutus Kirby, 1882. List Hym. Brit. Mus., 1:380. ♂.

Geographic range: This species is found in the Hudsonian and Canadian Life Zones from Georgia north into New Brunswick, Newfoundland, and Hudson Bay, west to Vancouver Island; south along the Rocky Mountains to New Mexico; and in the Pacific coast states of Oregon, Washington, and California. It has been established in Britain where it is often imported in timber.

California records:

Alameda Co.: Oakland, ♀ IX-15-48, pine lumber from Sierra (C.I.S.).

Amador Co.: Dew Drop Camp, 3 ♀, emerged III-31-55, *Abies concolor* Hopkins No. 34-02OE (R. G. Struble, C. B. Eaton, C.F.R.E.S.).

Contra Costa Co.: Lafayette, ♀, VII-6-50 (E. O. Essig, C.I.S.).

Los Angeles Co.: Alhambra, ♀ (E. T. Olson, L.A.C.M.); Los Angeles, ♀, IX-8-26, spruce (Western Hardware Co., C.F.R.E.S.).

Madera Co.: Miami Range Station, 2 ♀, VI-1942 (C.I.S.).

Mendocino Co.: Mendocino, ♂, XI-15-57 (J. R. Helfer, Don Burdick).

Modoc Co.: Buck Creek Ranger Sta., 5 ♀, 5 ♂, X-25-29, *Pinus ponderosa* (A. Wagner, C.F.R.E.S.); Crowder Flat, ♀, IX-1-27, *Pinus ponderosa* (F. P. Keen, C.F.R.E.S.).

San Francisco Co.: San Francisco, ♀, XI-5-09 (C.A.S.); ♀, VII-1-17 (E. P. Van Duzee, C.A.S.); ♀, IX-29-25 (R. M. Woods, C.A.S.); ♀, 9-10-33 (C. E. Browning, C.S.D.A.).

Siskiyou Co.: Yreka, ♀ (H. E. Burke, C.F.R.E.S.).

Tuolumne Co.: Pinecrest, ♀, IX-28-33 (C.I.S.).

Hosts: Specimens have been reared from, or collected on, the following conifers: *Abies balsamea*, balsam fir; *Abies concolor*, white fir; douglas fir; pine; and spruce.

Parasite: *Rhyssa lineolata* (Kirby).

Biology:

The life history has been carefully studied by Chrystal (1928, 1930) and Chrystal and Meyers (1930). The following notes are extracted from their observations.

The flight period seems to be at its height from July to October; some wasps have been taken as early as June and as late as November. The adults fly in bright sunshine making a characteristic noisy buzz. As with other species of Siricidae males appear less frequently in collections. Workers in Denmark observed that siricids pair in the treetops, after which the females descend to the lower levels for egg laying.

Females normally oviposit in warm sunny weather. Before the final site for oviposition

is selected the female closely examines the bark with the antennae and the ovipositor. In a matter of less than ten minutes she begins to oviposit and may lay from 1 to 7 eggs in the oviposition tunnel, spaced at intervals while withdrawing the ovipositor: 3 to 4 fusiform translucent eggs per tunnel seem to be average. Sometimes the females are unable to withdraw the ovipositor and die in this position. The tunnel penetrates the wood at a right angle to the axis of the trunk, or at a slant, to a depth of 6 to 20 mm. Chrystal (1928) found by dissection that females in England possessed 300 to 400 eggs on the average. They are 1.25 to 1.5 mm. in length and are markedly constricted at at the posterior end and bluntly rounded at the other.

The incubation period is 3 to 4 weeks, after which the young larva bites its way out of the egg and begins to burrow into the wood at right angles to the oviposition tunnel. The larva tunnels in the outer sapwood at first; when it has attained the length of 8 to 9 mm. it turns inward toward the heartwood. After reaching the heartwood the larva then curves round, returning toward the surface in preparation for pupation and the emergence of the adult. Chrystal (1929) feels that 10 inches to 1 foot is a fair estimate of the maximum length of the tunnel. The larva molts three to four times and packs the cast skins with the frass at intervals in the tunnel. The terminal spine on the larva is for the purpose of packing the frass or boring dust in its tunnel as well as serving as a terminal support, being driven into the sides of the tunnel for this purpose.

The pupal chamber is formed at the end of the larval tunnel and in a direct line with the outside. The adult cuts its way to freedom through the remaining distance which is usually less than three-quarters of an inch. Males are normally somewhat closer to the surface than females. The duration of the pupal stage is 5 to 6 weeks. The minimum period for the complete cycle is two years.

Discussion:

A Holarctic species, generally believed to be American in origin. Benson (1951) considers it to be adventitious in Great Britain.

Some authors have confused this species with the Palearctic *juvencus* (L.) or have described it as a subspecies of *juvencus*. The systematics of the species need clarification.

Sirex longicauda Middlekauff

Sirex longicauda Middlekauff, 1948, Pan-Pac. Ent., 24 (4):189-190. Type ♀, California.

Geographic range: California.

California records:

Alameda Co.: Berkeley, ♀, IV-1932, *Abies concolor* (C.A.S.). Holotype.

Madera Co.: Miami Ranger Station, ♀, VI-1942 (C.F.R.E.S.). Paratype.

Mariposa-Tuolumne cos.: Yosemite Nat'l. Park, ♀, IX-25-33 (C.I.S.); 5 ♀, IX-28-33, white fir (C.I.S.).

San Bernardino: Hanna Flats, ♀, IX-28-52 (Arnold Menke, Jr., Arnold Menke); Silver Lake, ♀, IX-1932 (H. Plank, C.S.D.A.).

Host: *Abies concolor*, white fir.

Discussion:

This species closely resembles *areolatus* in body color and length of ovipositor, but may be readily separated on the basis of the reddish tibiae and tarsi and the slightly more constricted cornus. First described in 1948, it is still rare in collections; the male is unknown.

Sirex obesus Bradley

Sirex obesus Bradley, 1913, Jour. Ent. Zool., 5:12. Type ♀, Arizona.

Geographic range: California, Arizona.

California records:

Mariposa-Tuolumne cos.: Yosemite Nat'l. Park, ♀, VIII-14-35, *Pinus contorta*, (G. R. Struble, C.F.R.E.S.).

Nevada Co.: Nevada City, ♀, VIII-1906 (J. P. Baumberger, C.A.S.).

Host: *Pinus contorta*, lodgepole pine.

Discussion:

This relatively rare species is similar to *californicus* in having the deep blue head, body, and appendages and a short ovipositor which seldom projects more than 2 to 3 mm. beyond the tip of the cornus. It may be distinguished by the dark, violaceous wings and white tarsal pads. The male is unknown.

Genus *Urocerus* Geoffroy, 1762

Members of this genus have been found in Europe, Palearctic Asia, Japan, North Africa, and North America. About 20 species and subspecies have been described, 5 of which occur in North America and 3 in California. It con-

tains our largest species, some members attaining a body length (head to tip of cornus) of nearly 40 mm. Females oviposit in the trunks of various conifers in the genera *Abies, Pinus, Tsuga, Picea, Pseudotsuga,* and *Libocedrus.*

Species in this genus possess in common with *Xeris* a distinctive pale spot behind the eye, a constricted cornus, and vein CU_1 in the forewing which is usually completely absent. They may be distinguished from *Xeris* as follows: head lacks a lateral carina, the ovipositor is usually shorter than the forewing, hind wing possesses a closed anal cell, the eye is oval instead of nearly round, and the hind tibiae possess two apical spurs.

California species may be separated by means of the following key.

Key to the California Species of *Urocerus*

1. Females; ovipositor present 2
   Males; ovipositor absent 4

Females

2. Abdomen black with segments VII and VIII and sometimes II, yellow . . . . . *gigas flavicornis* (p. 68)
   Abdomen usually entirely black or blue black 3
3. Wings golden yellow; flagellum of antennae and basal half of tibiae and metatarsi golden yellow; a large light-colored spot behind eye . . . . . *californicus* (p. 66)
   Wings infuscated, brown; most of flagellum, a spot behind eyes, sometimes lateral spots on the abdomen and the bases of the tibiae and basitarsi white . *albicornis* (p. 66)

Males

4. Abdomen reddish brown; wings golden yellow; legs and antennae reddish brown . . . . . *californicus* (p. 66)
   Abdomen with segments III to VI yellow, the remainder black; wings nearly hyaline . . 5
5. Hind basitarsus 4.1 to 5.6 times as long as broad . . . . . *albicornis* (p. 66)
   Hind basitarsus 6.4 to 8.1 times as long as broad . . . . . *gigas flavicornis* (p. 68)

Urocerus albicornis (Fabricius)

Sirex albicornis Fabricius, 1781, Species Insectorum, 1:419. Type ♀, North America.
Urocerus abdominalis Harris, 1841, ♂, Rpt. Ins. Injurious to Veg., p. 392.
Sirex stephensi Kirby, 1882, ♀, List Hym. Brit. Mus., 1:375.

Geographic range: From British Columbia, northern Ontario, Nova Scotia, and Newfoundland south to Louisiana. South in the Rockies to New Mexico and in the Pacific coast states to California. A common insect in the Canadian Life Zone extending into the Hudsonian.

California records:
Humbolt Co.: Weott, ♀, VII-13-29 (E. D. Van Dyke, C.A.S.).
Madera Co.: Miami Ranger Station, ♀, VI-1942 (C.I.S.).
Shasta Co.: Sweet Briar Camp, ♀, (C. L. Fox, C.A.S.). Castella, VII-1912 (Baumberger, 1915).

Hosts: Specimens have been reared from, or collected on, the following conifers: *Abies balsamea,* balsam fir; pine; hemlock; spruce; firs; Douglas fir; cedar.

Parasites: *Megarhyssa nortoni quebecensis* (Prov.) and *Rhyssa lineolata* (Kirby) have been reared from this species.

Discussion:
This species is relatively uncommon in California, and only a few locality records are available.

The female is reported to prefer freshly killed wood in which to oviposit. The life cycle is reported by Belyea (1952) to last two years from egg to adult. Other authors state that the cycle may be completed in one year. The larval burrows run in all directions and are closely packed with a very fine dustlike frass.

Our only other *Urocerus* with entirely black abdomen is *californicus.* The brownish infuscated wings will serve to separate *albicornis* females from the golden-winged females of *californicus.*

Urocerus californicus Norton

Urocerus albicornis var. *californicus* Norton, 1869, Trans. Amer. Ent. Soc., 2:360. Type ♀, California.
Urocerus fulvus Cresson, 1880, ♂, Trans.

Amer. Ent. Soc., 8:35.

Urocerus flavipennis Kirby, 1882, ♀, List Hym. Brit. Mus., 1:380.

Geographic range: Alpine regions in Arizona, British Columbia, California, Colorado, Idaho, Mexico, Nevada, New Mexico, Oregon, Utah, Washington.

California records:

Alameda Co.: Oakland, ♀, VIII-22-58 (C.I.S.).

Calaveras Co.: Camp Wolfboro, ♂, VIII-1-39 (C.I.S.); Dorrington, 2 ♀, VIII-7-33 (R. P. Allen, C.A.S.); 3 ♀, IX-13 to 14-33 (R. P. Allen, C.A.S.).

El Dorado Co.: China Flat, 2 ♀, VIII-2-49 (J. W. MacSwain, C.I.S.); Eagle King Mine, Grizzly Flats, ♀, IX-8-38 (E. P. Chace, L. A. C.M.); Fallen Leaf Lake, ♀, VI-24-28 (L.A.C. M.); ♀, VI-23 to 30-1934 (Carl D. Duncan, S.J.S. C.); Pyramid Ranger Sta., 2 ♀, VIII-1-49 (J. W. MacSwain, C.I.S.); ♀, VIII-10-15 (F. B. Herbert, C.F.R.E.S.); 2 ♀, VIII-4 to 6-15 (C.F.R.E.S.); 10 ♀, VIII to IX-1914, *Abies concolor* (H. E. Burke, C.F.R.E.S.); ♀, IX-3-14, *Libocedrus decurrens* (H. E. Burke, C.F.R.E.S.); Snowline Camp, ♀, VI-29-48 (P. D. Hurd, C.I.S.); 3 ♀, ♂, VII-14-48 (A. Bartel, C.I.S.); Vade, ♀, *Abies magnifica* (H. E. Burke, C.F.R.E.S.); Echo Lake, 3 ♀, VIII-10-24 (E. O. Essig, C.I.S.); ♀, VIII-14-55 (H. R. Moffitt, U.C.D.). Lake Tahoe, ♀, 2♂, IX-1929 (C.I.S.).

Fresno Co.: Huntington Lake, 7,000′ elev., 4 ♀, VII-18-19(?) (E. P. Van Duzee, F. C. Clark); 2 ♀, VII-21-30 (L.A.C.M.); ♀, VII-27-19(?) (E. P. Van Duzee, C.A.S.); S. Fork Kings River Canyon, 5,000′ elev., ♀, VII-4-10 (E. C. Van Dyke, C.A.S.).

Los Angeles Co.: Crystal Lake, ♀, VII-1-52 (L. A. Stange, L.A.C.M.).

Madera Co.: Bass Lake, ♀, VIII-31-34 (C.I. S.); Whiskey Creek, ♀, VIII-3-31 (K. A. Salman, C.F.R.E.S.).

Mariposa Co.: Pohono Trail, Yosemite Nat'l. Park, ♂, VIII-8-33 (C.I.S.); Yosemite Valley, ♀, VII-8-21 (E. C. Van Dyke, C.A.S.); 3 ♀, ♂, VI-1933 (C.I.S.); Tuolumne Meadows, 8,500′ elev., ♀, VII-1915 (C. L. Fox, C.A.S.).

Mariposa-Tuolumne cos.: Yosemite Nat'l. Park, 7,000-7,750′ elev., ♀, VII-30-38 (C.I.S.); Yosemite, 4 ♀, IX-28-33 white fir, (C.F.R.E.S.); ♀, IX-18-13 (J. J. Sullivan, C.F.R.E.S.); ♀, VIII-1914 (J. J. Sullivan, C.F.R.E.S.); ♀, VI-24-29 (J. Horning, L.A.C.M.).

Modoc Co.: Lake City, ♀, VII-10-22 (C. L. Fox, C.A.S.); Modoc Nat'l. Forest, ♀, XI-6-30, *Abies concolor* (C. A. Johnson, C.F.R.E.S.).

Napa Co.: St. Helena, ♀, VII-7-09 (C.A.S.).

Nevada Co.: Sagehen, nr. Hobart Mills, 2 ♀, IX-5-57 (E. G. Linsley, C.I.S.); Donner Summit, ♀, V-1940 (E. Swift, C.S.D.A.); Washington, 5 mi. S., ♀, VI-30-57 (H. W. Michalk, U.C.D.).

Placer Co.: Cisco, ♀, VII-1924 (F. E. Blaisdell, C.A.S.); ♀, VII-1911 (C. Van Geldern, C.A.S.); 6 ♂, ♀, VI-1910 (C. Van Geldern, C.A.S.); Mich. Bluff, ♀ (E. R. Leach, C.A.S.); Middle Fork of American River, ♀, VIII-15-07 (C. L. Fox, C.A.S.); Whiskey Creek, 2 ♀, XI-3-48 (Peter C. Ting); Carnelian Bay, Lake Tahoe, ♀, IX-24-56 (R. M. Bohart, U.C.D.).

Plumas Co.: Hartless, ♀, IX-7-13 (H. E. Burke, C.F.R.E.S.); McKinney Creek, ♀, IX-1914, (C.F.R.E.S.); Meadow Val., 5,000-6,000′ elev., ♀, VII-20-39 (H. T. Reynolds, C.I.S.); 2 ♀, VII-27-24 (E. C. Van Dyke, C.A.S.); Onion Valley, ♀, VIII-11-13, *Abies concolor*, (H. E. Burke, C.F.R.E.S.); ♀, IX-15-13 (H. E. Burke, C.F.R.E.S.); Quincy, ♀, IX-6-41 (W.W.M.); Bucks Lake, ♀, VIII-29-56 (R. F. Wilkey, C.S. D.A.).

Riverside Co.: Marion Mt. Camp, San Jacinto Mts., ♀, VII-1-52 (J. W. MacSwain, C.I.S.).

San Bernardino Co.: Beak Lake, ♀, VII-4-19 (J. D. Martin, C.A.S.); Hanna Flat, ♀, VI-20-52 (Arnold Menke, Jr., Arnold Menke); San Bernardino Mts., 7,500′ elev., ♀, VII-2-17 (J. D. Martin, C.A.S.); Bluff Lake, 2 ♀, July-August, 1948 (G. Chrisman, C.I.S.) Lake Arrowhead, ♀, 6-8-40 (N. Gratz, L.A.C.M.); ♂, VIII-19-40 (N. Gratz, L.A.C.M.).

Santa Clara Co.: Palo Alto, ♀, VIII-9-54 (R. Dixon, U.C.D.).

Santa Cruz Co.: Big Basin, 2 ♀, VIII-7-56 (Don Meadows, L.A.C.M.); Felton, ♀, IX-8-48 (Ralph Nix, Donald Burdick); Soquel, ♀, VIII-11-32, white fir (C.F.R.E.S.).

San Francisco: San Francisco, ♀, VIII-27-58 (C.I.S.).

Shasta Co.: ♂, VII-6-21 (J. A. Kusche, C. A.S.); Hat Creek, ♀, VIII-7-54 (D. D. Linsdale, C.I.S.); Lassen Nat'l. Park, ♀, IX-21-40 (T. G. Aitken, C.I.S.).

Sierra Co.: ♀, X-1927 (C.A.S.); Calpine, ♀, VIII-27-48 (J. W. MacSwain, C.I.S.); Gold Lake, ♀, VII-20-21 (C. L. Fox, C.A.S.); Sierra City, ♀, X-1-36, cedar (A. Michie, C.S.D.A.).

Siskiyou Co.: Shasta Retreat, 2,416′ elev., ♀, VII-3-05 (F. E. Blaisdell, C.A.S.); Shasta Springs, ♀, VIII-1-20 (C. E. Masson, C.A.S.); Big Flat, ♀, VIII-4-31 (R. L. Usinger, C.I.S.); Yreka, ♀, VII-20-40 (J. O. McKinney, C.S.D.A.).

Sonoma Co.: Santa Rosa, ♀ (no date) (Lois

B. Stiles, Donald Burdick).

Tehama Co.: Red Bluff, ♀, VIII-1929 (L.A. C.M.).

Trinity Co.: Carrville, ♀, VII-3-13 (E. C. Van Dyke, C.A.S.).

Tulare Co.: Giant Forest, 6 ♀, VIII-20-19, *Abies concolor* (A. Wagner, C.F.R.E.S.); Mineralking, ♀, IX-14-53 (R. W. Parker, L.A.C.M.); Sequoia Nat'l. Park, 2 ♀, IX-10-18, *Abies concolor* (R. D. Hartman, C.F.R.E.S.); ♀, VII-26-39 (C.A.S.); Sequoia Nat'l. Park, Crystal Cave area, more than 9,000' elev., ♀, VII-1940 (C.A.S.); Three Rivers, ♀, IX-10-52 (J. W. Hinerman, C.I.S.); 2 ♀, VII-1918 (A. Wagner, C.F.R.E.S.); Sherman Pk. National Forest, ♀, X-6-37 (Romain Young, C.S.D.A.).

Tuolumne Co.: ♀, IX-14-56, on dead *ponderosa* (Roberta Hood, S.J.S.C.); Long Barn, 2 ♀, 1931, *Abies concolor* (R. G. Struble, C.F.R.E.S.); Pinehurst, 11 ♀, VII to VIII-1930, *Abies concolor* (R. G. Struble, C.F.R.E.S.); 2 ♀, VI-24, 26-31, *Abies concolor* (R. G. Struble, C.F.R.E.S.); ♀, VII-12-27 (C.A.S.); ♀, VII-10-29, white fir (C.F.R.E.S.); ♀, VIII-1936 (C.I.S.); Strawberry, ♀, VII-8-51 (R. W. Morgan, C.I.S.).

Hosts: Specimens have been reared from, or collected on, the following conifers: *Abies balsamea*, balsam fir; *Abies concolor*, white fir; *Abies magnifica*, California red fir; *Libocedrus decurrens*, incense cedar; Douglas fir; lodgepole pine.

Discussion:

It is the largest and possibly the commonest western siricid; the adult female may exceed an inch and a half in length from head to tip of cornus. Although *californicus* may attack several other genera of conifers it is primarily a fir feeder, readily attacking the balsam, white and red firs. It is our only siricid with a postocular white spot, black abdomen, and golden-yellow-colored wings and antennae.

The Bucks Lake female has a small yellow spot laterally above the spiracle on abdominal segment VIII.

Urocerus gigas flavicornis (Fabricius)

Sirex flavicornis Fabricius, 1781, Species Insectorum, 1:418. Type ♀, Labrador.

Sirex bizonatus Stephens (n.n.), 1892, Syst. Cat. Brit. Ins. Mand., p. 342.

Urocerus abdominalis Harris, 1841, ♂, Rept. Ins. Mass., p. 392.

Sirex latifasciatus, Westwood, 1874, ♂, Thesaurus Ent. Oxon., p. 114.

Urocerus riparius MacGillivray, 1893, ♂, Canad. Ent., 24:244.

Geographic range: Northern coniferous belt of North America south along the Rocky Mountains to Arizona and New Mexico, Mexico and in the Pacific coast states of Washington, Oregon, and California. Has been introduced into Britain in timber but is not established.

California records:

El Dorado Co.: Lake Tahoe, ♀, VII-1937 (C.I.S.).

Inyo Co.: Manigens Meadow, ♀, VII-1-47 (C.I.S.).

Hosts: Specimens have been reared from, or collected on, the following conifers: spruce, pine, fir, Douglas fir.

Discussion:

A somewhat smaller species than *californicus*. It is distinctively colored having abdominal segments VII and VIII and sometimes II, yellow.

Genus *Xeris* A. Costa 1894

The genus *Xeris* is Holarctic in distribution with but four known species. Three species, one of which is Holarctic, are recorded from North America. A fourth species is confined to the Himalayas.

The species of this genus possess a distinctive carina behind the eye; the hind wing is without a closed anal cell; the hind tibia has but one apical spur; and the eye is nearly round. Two of our species have the ovipositor longer than the body, and all possess a white spot behind the eye.

Key to the California Species of *Xeris*

1. Females; ovipositor present 2
   Males; ovipositor absent 4

Females

2. Cornus not constricted in middle or only slightly so (fig. 14); tibiae and tarsi usually considerably lighter than femora; antennae basally darker than apical part of flagellum . . . . . *macgillivrayi* (p. 69)

Cornus distinctly constricted in middle (fig. 15); legs mostly unicolorous reddish 3

3. Abdomen except first segment, reddish . . . . . *morrisoni* (p. 69)
Abdomen entirely black . . . *spectrum* (p. 70)

Males

4. Abdomen black . . . . . *spectrum* (p. 70)
Abdomen mostly reddish 5

5. Postocellar area very rugose; median furrow shallow, broadly rugose (fig. 6) . . . . . *macgillivrayi* (p. 69)
Postocellar area sparsely pitted not rugose, polished, a distinct, narrowly rugose median furrow (fig. 7) . . . . . *morrisoni* (p. 69)

Xeris macgillivrayi Bradley

Xeris macgillivrayi Bradley, 1913, Jour. Ent. Zool., 5:24. Type ♀, Washington.

Geographic range: California, Washington.

California records:

Alameda Co.: Berkeley, ♀, XI-25-22 (S. Flanders, (C.I.S.); ♀, XI-25-22, Monterey cypress (S. Flanders, C.I.S.).

Modoc Co.: Hackamore, ♀, IX-1930, attracted to fire (Wagner, C.F.R.E.S.); Willow Ranch, 6 ♀, ♂, II-1934, *Libocedrus decurrens* (K. A. Salmon, C.F.R.E.S.).

San Mateo Co.: 5 ♀, X-21 to 25-25 (B. H. Murray, C.A.S.).

Santa Clara Co.: Palo Alto, 76 ♀, 114 ♂, VIII to X, 1932, Monterey cypress (H. E. Burke, C.F.R.E.S.).

Tuolumne Co.: Pinecrest, ♂, X-16-33 (R. P. Allen, C.I.S.).

Hosts: *Cupressus macrocarpa*, Monterey cypress; *Libocedrus decurrens*, incense cedar.

Discussion:

The unconstricted cornus of the female, the darker femora, and basal part of the antenna will distinguish *macgillivrayi* from our other species. A female was reported attracted to fire.

Xeris morrisoni (Cresson)

Urocerus morrisoni Cresson, 1880, Trans. Amer. Ent. Soc., 8:35. Type ♀, Colorado.

Urocerus tarsalis Cresson, 1880, ♀, Trans. Amer. Ent. Soc., 8:25, 67.

Urocerus indecisus MacGillivray, 1893, ♂, Canad. Ent., 25:243.

Geographic range: High coniferous forests of northwestern United States into Canada. Arizona, British Columbia, California, Colorado, Nevada, Oregon, Utah, Washington.

California records:

Alpine Co.: Lake Alpine, ♀, VII-13-35 (R. P. Allen, C.A.S.).

Calaveras Co.: Camp Wolfboro, ♀, VIII-1-39 (C.I.S.); Dorrington, ♀, VII-7-33 (R. P. Allen, C.A.S.).

El Dorado Co.: Echo Lake, ♀, VII-13-31 (E. O. Essig, C.I.S.); ♂, VII-12-24 (P. H. Wymore, C.A.S.); ♀, ♂, VII-16 to 18-33, red fir (C.I.S.); 7 ♀, 7 ♂, VII-10-24 ovipositing in red fir (E. O. Essig, C.I.S.); ♂, VII-20-28 (E. O. Essig, C.I.S.); Fallen Leaf Lake, ♀, VII-17-15, *Abies concolor* (H. E. Burke, C.F.R.E.S.); ♀, VII-1915 (L. S. Rosenbaum, C.A.S.); 2 ♀, VII-16-15, *Abies concolor* (F. B. Herbert, C.F.R.E.S.); 7 ♀, VIII-1931 (O. H. Swezey, C.A.S.); ♀, VII-24-15 (E. C. Van Dyke, C.A.S.); Glen Alpine Creek, 3 ♀, VII-16-20 (E. P. Van Duzee, C.I.S.); Snowline Camp, ♀, VII-4-48 (O. E. Myers, Donald Burdick); 2 ♀, 2 ♂, VI-30-48 (C. D. MacNeill, Donald Burdick); 14 ♀, 7 ♂, VI-25 to 30-48 (J. W. MacSwain, A. Bartel, L. W. Quate, D. Carter, P. D. Hurd, C.I.S.); 8 ♀, 2 ♂, VII-3 to 4-48 (P. D. Hurd, C.I.S.); 4 ♀, 2 ♂, VII-7-48 (P. D. Hurd and S. A. Sher, C.I.S.).

Fresno Co.: Huntington Lake, 3 ♀, 2 ♂, VII-12 to 18-19 (E. P. Van Duzee, C.A.S.).

Madera Co.: Soquel Meadow, Willow Creek, ♀, VII-1951 (W. C. Day, C.A.S.).

Mariposa-Tuolumne cos.: Yosemite Nat'l. Park, ♀, VII-10-13, *Pinus contorta* (J. J. Sullivan, C.F.R.E.S.); ♀, VIII-1-38 (C.I.S.).

Modoc Co.: Hackamore, 2 ♀, VII-2-50 (M. Wasbauer, Donald Burdick); ♀, VII-5-50, *Pinus ponderosa* (M. Wasbauer, Donald Burdick).

Napa Co.: Mt. St. Helena, ♀, V-12-26 (M. C. Van Duzee, C.A.S.).

Nevada Co.: Sagehen, nr. Hobart Mills, ♀, VII-16-54 (R. H. Goodwin, C.I.S.).

Placer Co.: Cisco, ♂, VII-1911 (C. Van Geldern, C.A.S.); Towle, ♀, VII-15-33 (C.I.S.).

Plumas Co.: Bucks Lake, ♂, VII-14-49 (J. W. MacSwain, C.I.S.); Meadow Valley, 3,500-4,000´ elev., ♂, VI-16-24 (E. C. Van Dyke, C.A.S.); Onion Valley, ♀, V-19-16, *Abies concolor* (H. E. Burke, C.F.R.E.S.).

Riverside Co.: Marion Mt. Camp, San Jacinto Mts., ♀, VII-1-52 (W. V. Garner, C.I.S.).

San Bernadino Co.: Falls Public Camp, ♂, VII-2-56 (Arnold Menke, L.A.C.M.).

San Francisco Co.: San Francisco, ♀, VII-1908 (E. C. Van Dyke, C.A.S.).

Santa Cruz Co.: Santa Cruz Mts., ♀, V-20-26 (J. A. Kusche, C.A.S.).

Shasta Co.: 3 mi. S.E. Mt. Lassen, ♀, VII-18-53, *Abies magnifica* (H. W. MacSwain, C.I.S.).

Siskiyou Co.: McCloud, ♀, VII-27-14 (E. C. Van Dyke, C.A.S.); 2 ♂, VII-2-14 (E. C. Van Dyke, C.A.S.).

Trinity Co.: ♂, *Pinus ponderosa* (C.F.R.E.S.).

Tulare Co.: Sequoia Nat'l. Park, ♀, summer 1937 (Jack Applegarth, S.J.S.C.).

Tuolumne Co.: Mather, ♂, VII-10-30 (E. C. Zimmerman, C.A.S.); Pinecrest, ♀, VI-18-31 (C.F.R.E.S.); 2 ♀, VII-1 to 15-30 (G. B. Struble, C.F.R.E.S.); ♀, VII-7-29, *Abies concolor* (W. D. Edmonston, C.F.R.E.S.); 2 ♀, VI-26-29, *Abies concolor* (H. E. Burke, C.F.R.E.S.); ♂, VII-15-29, *Abies concolor* (H. E. Burke, C.F.R.E.S.); Strawberry Lake, ♂, VII-1949 (Browning, C.S.D.A.).

Hosts: *Abies concolor*, white fir; *Abies magnifica*, red fir; *Pinus contorta*, lodgepole pine; *Pinus ponderosa*, yellow pine.

Parasites: MacSwain and others took large numbers of *Megarhyssa nortoni nortoni* (Cresson) from trees where *morrisoni* had been ovipositing.

Discussion:

This common *Xeris* is widely distributed in the mountains of California where it attacks mostly firs and lodgepole pine. Essig (1926) reports taking females ovipositing in dead and dying white fir and lodgepole pine. The reddish abdomen will serve to distinguish it from the closely related *spectrum*.

Xeris spectrum (Linnaeus)

Ichneumon spectrum Linnaeus, 1758, Syst. Nat. ed. 10, 1:560. Type ♀, Sweden.

Urocerus nanus O. F. Muller, 1776, ♂, Zool. Dan. Prod.

Sirex emarginatus Fabricus, 1793, ♂, Ent. syst., 2:128.

Urocerus caudatus Cresson, 1865, ♀, Proc. Ent. Soc. Philadelphia, 4:247.

Sirex melancholicus Westwood, 1874, ♂, Thesaurus Ent. Oxon., p. 116.

Geographic range: Holarctic in northern coniferous forests, extending into mountains farther south. North America, Eurasia, Japan, Turkestan, the Caucasus, Himalayas, and Atlas Mountains. Introduced but not established in Britain. In North America it has been recorded from Alaska, British Columbia, California, Colorado, Maine, Nevada, New Brunswick, New Hampshire, Nova Scotia, Oregon, Utah, Washington.

California records:

El Dorado Co.: Echo Lake, 6 ♂, VII-10 to 24-24 (E. O. Essig, C.I.S.); Snowline Camp, ♀, VII-7-48 (J. W. MacSwain, C.I.S.); ♀, VIII-3-48 (J. W. MacSwain, C.I.S.).

Lassen Co.: Blue Lake, 2 mi. N.W., ♂, VII-19-47 (D. W. Adams, C.I.S.)

Mariposa Co.: Lake Tenaya, Yosemite Nat'l. Park ♀, VII-14-18, *Pinus murrayana* (J. E. Patterson, C.F.R.E.S.); Tuolumne Meadows, ♀, VII-25 to VIII-5-15 (C. L. Fox, C.A.S.).

Mariposa-Tuolumne cos.: Yosemite Nat'l. Park, ♀, VII-10-13, *Pinus contorta* (J. J. Sullivan, C.F.R.E.S.).

Plumas Co.: Bucks Lake, ♀, VI-23-49 (J. W. MacSwain, C.I.S.).

Host: The lodgepole pine, *Pinus contorta*, is probably the favorite host in California.

Parasite: *Rhyssa persuasoria* L.

Discussion:

Females of this dark-colored species may be separated from *morrisoni* on the basis of the entirely black abdomen.

Genus *Tremex* Jurine, 1807

More than 20 species in this genus are known from Europe, Palearctic and tropical Asia, Borneo, New Guinea, Africa, and North America; some species are of doubtful validity. One species, with several color phases, has been described from North America.

The genus *Tremex* is so distinctive that it is placed in a separate subfamily. The antennae are short, more or less fusiform at most as long as head and thorax combined; the labial palpi are two-segmented; the forewings lack cross vein 2 r-m and possess an appendicular vein (3A); the hind wings lack an anal cell and the hind tibiae possess but a single apical spur.

Tremex columba (Linnaeus)

(Pigeon tremex)

Sirex columba Linnaeus, 1763, Amoenitates Academicae, 6:412. Type ♀, "Amerika."

Sirex pennsylvanicus De Geer, 1773, Mem. Serv. Hist. des Ins., 3:593. ♀.

Sirex cinctus De Geer, 1773, Illus. Nat. Hist., 2:72. ♀.

Sirex americana Christ, 1791, Naturg. Ins., p. 412 ♀.

Tremex obsoletus Say, 1823, West. Quart. Rept., 2:73. ♂.

Tremex sericeus Say, 1823, West. Quart. Rept., 2:73. ♀.

Tremex servillei Brullé, 1846, Hist. Nat. Ins., Hym., 4:645. ♀.

Tremex maurus Westwood, 1874, ♂, Thesaurus Ent. Oxon., p. 116. ♂.

Tremex columba aureus Bradley, 1913, Jour. Ent. Zool., 5:25, 26. ♀.

Geographic range: Widely distributed over the United States and southern Canada, Arizona, California, Colorado, Connecticut, Georgia, Illinois, Indiana, Kansas, Massachusetts, Maryland, Michigan, Missouri, New Jersey, New Mexico, New York, Nova Scotia, Ontario, Pennsylvania, Quebec, Tennessee, Utah.

California records:

Riverside Co.: Neighbours, ♂, V-1929 (L. A.C.M.).

Hosts: Specimens have been reared from, or collected on, the following deciduous trees: apple, beech, birch, box elder, elm, hackberry, hickory, maple, oak, pear, sycamore.

Parasites: The cynipid *Ibalia maculipennis* Haldeman and the ichneumonids *Megarhyssa atrata* (F.), *Megarhyssa greenei greenei* Viereck, and *Megarhyssa macrurus macrurus* (L.) have been recorded as parasites of the pigeon tremex. An extensive bibliography on the biology of *Megarhyssa* spp. is given by Townes and Townes (1951).

Biology:

Information on the biology of the pigeon tremex is very scanty and confined entirely to scattered short notes. No exhaustive studies have ever been made. Adults can be collected from June to September. They oviposit in dead or weakened deciduous trees or those dying as a result of disease or other cause. Fattig (1949) noted a female ovipositing near Atlanta, Georgia at 6:00 A.M. It was the only one noted from June, 1947, to June, 1948, despite many observations of an infested tree.

The female deposits her eggs singly to a depth of 10 to 12 mm.

The larvae, which obtain a length of 40 mm., bore tunnels in the trunks and aid in the disintegration of the trees. They are of little or no economic importance. It is stated that the larvae probably completes its growth and transforms to a pupa within a year, but no definite data are available. Fattig noted that when *Tremex* emerged from the tree it dropped to the ground and almost at once was off in a flash.

Discussion:

The adults of this species vary in color and markings, and three so-called races have been recognized in the past, based upon these variations. To a considerable extent these races are geographical with overlapping ranges.

In the typical race, *columba*, the abdomen is black with ocher-yellow bands and spots along the sides. It is most commonly found in northeastern United States and southeastern Canada. In the race *aureus* the ground color of the abdomen is yellow and the markings black. The wings are golden yellow. This is the common form in Colorado, New Mexcio, Arizona, and California. In *sericeus* the entire body is fulvous, the legs beyond the femora yellow, and the wings dark reddish brown. This race is found in the southeastern United States and as far north as Pennsylvania and west into Colorado, New Mexico, Arizona, and California.

A careful study in the light of modern systematic thinking is needed to clarify the status of these color forms, to determine if they are populations which are more or less isolated as distinct geographical or ecological races and hence deserve the status of subspecies. The recent trend has been to consider them as infrasubspecific categories.

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PLATES

Plate 4

Fig. 1. Forewing of *Sirex*.
Fig. 2. Head and antenna of *Xeris*. Dorsal view.
Fig. 3. Fore- and hindwing of *Tremex*.
Fig. 4. Antenna of *Tremex*.
Fig. 5. Anal region of hindwing, *Urocerus*.
Fig. 6. *Xeris macgillivrayi*, male. Dorsal view of head.
Fig. 7. *Xeris morrisoni*, male. Dorsal view of head.
Fig. 8. *Sirex longicauda*, female. Dorsal view of cornus and ovipositor.
Fig. 9. *Sirex obesus*, female. Dorsal view of cornus and ovipositor.
Fig. 10. *Sirex cyaneus*, female. Dorsal view of cornus and ovipositor.
Fig. 11. *Sirex californicus*, female. Dorsal view of cornus and ovipositor.
Fig. 12. *Sirex behrensii*, female. Dorsal view of cornus and ovipositor.
Fig. 13. *Sirex areolatus*, female. Dorsal view of cornus and ovipositor.
Fig. 14. *Xeris macgillivrayi*, female. Dorsal view of cornus and ovipositor.
Fig. 15. *Xeris morrisoni*, female. Dorsal view of cornus and ovipositor.
Fig. 16. *Xeris morrisoni*, female. Lateral view of head.
Fig. 17. *Urocerus californicus*, female. Lateral view of head.

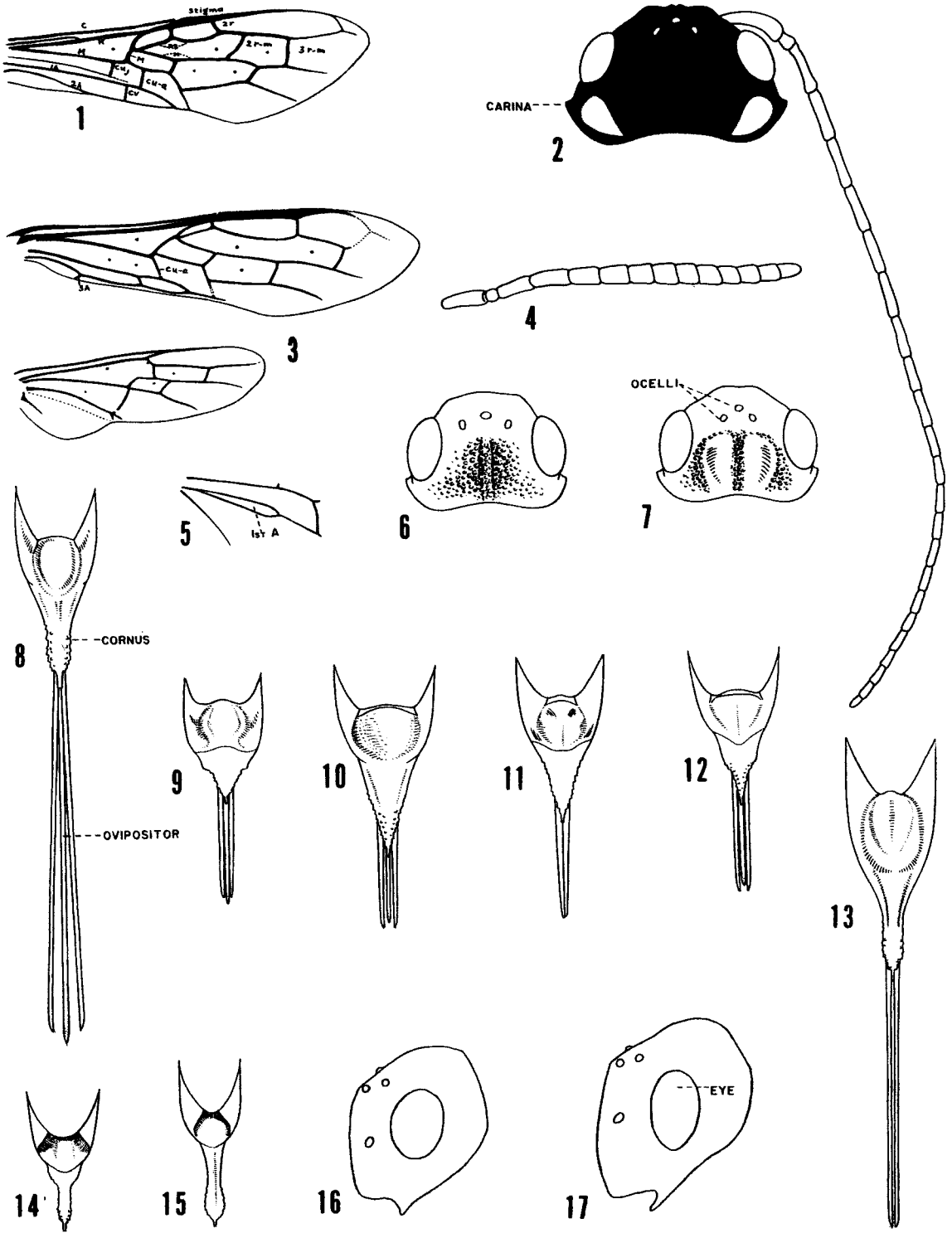
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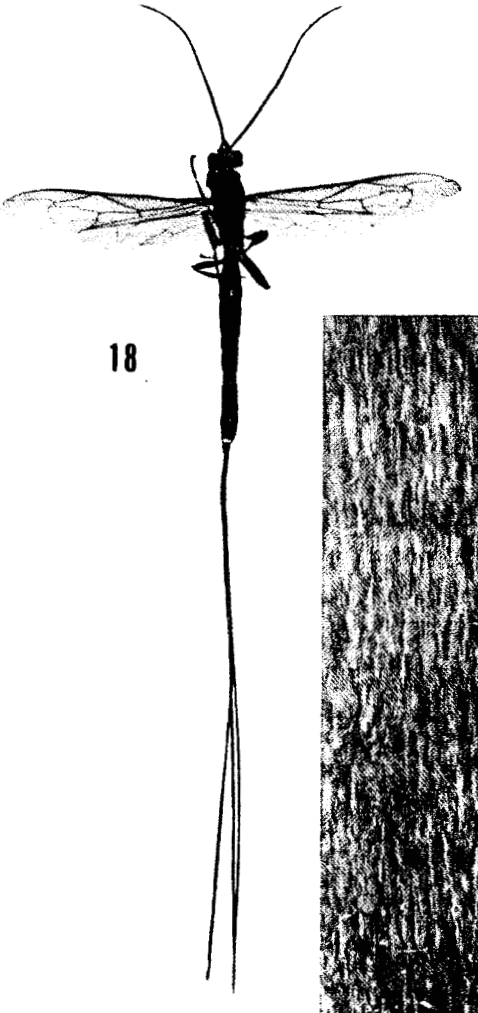
Plate 5

Fig. 18. Female *Megarhyssa nortoni nortoni* (Cresson), an ichneumonid parasite of larval woodwasps. Slightly larger than natural size.

Fig. 19. Female *Ibalia ensiger* Norton, a cynipid parasite reared from a log infested with *Sirex behrensii* (Cresson). Three times natural size.

Fig. 20. Section of redwood lumber showing female *Sirex areolatus* (Cresson) attempting to cut her way to freedom. About natural size.



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