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OBSERVATIONS ON HOST-PARASITE RELATIONSHIPS AND SEASONAL HISTORY OF TICKS IN SAN MATEO COUNTY, CALIFORNIA[1]

Carol O. Mohr[2], D Elden Beck, and Elias P. Brinton[3]

During the course of an investigation into the interrelationships of parasite and host populations in San Mateo County, California, data came to hand concerning populations of ticks on a number of species of small mammals, lizards, and birds. Since no studies appear to have been published concerning ticks in climates and faunal areas characteristic of the coastal zone, we believe it worthwhile to provide the following data.

Study Area and Procedure

The study area consisted of a meadow and an adjoining hillside approximately three miles east of the Pacific coast. It was about two acres in size at an elevation of from 450 to 600 feet above sea level. A ridge about 1,250 feet in elevation shields the area somewhat from coastal fog which frequently covers the meadow. Killing frosts occur late in December and end early in February. Average temperatures for January are 50° F, and 68° F for July. Precipitation averages 6 inches in January and 0.01 inches in July, with 22 inches per year.

The area is within the San Francisco Wildlife Refuge and is well populated by mule deer, *Odocoileus heminous*. Dogs from nearby residential areas frequently entered the refuge. Grey foxes, *Urocyon cineroargenteus*, also were common. No domestic stock has been pastured in the area for scores of years, except three horses which were present for a few weeks during the summer of 1961.

Kartman et al (1962) described the same general area in some detail when they studied its cricetid fauna and flea consortes in relation to an outbreak of plague. Our study area is the southernmost part of their location, designated by them as Area 5. In their publication, Figure 4 shows the fluctuations in populations at that time for meadow mice, *Microtus californicus;* harvest mice, *Reithrodon-*

1. This investigation was supported in part by a research grant (E-3653) from the National Institutes of Health, Division of Research Grants, U. S. Public Health Service.

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tomys megalotis; and deer mice, *Peromyscus maniculatus* in this and adjoining areas.

For the most part in our study, mice and birds were live-trapped. Most of the lizards were caught by hand. Some of the mice and birds were caught during afternoons of the day on which traps were set; others were taken from traps early the next morning.

The ticks on the hosts were counted by use of a hand lens so far as possible. When the clusters of ticks were so numerous that counting became uncertain, the host was killed, wrapped, and brought to the laboratory for a more accurate count. Otherwise, a sample collection of parasites was removed from the live host for species identification. The host was then released to permit further study of its home range and relation to home ranges of other individuals and species.

The field work was done by William A. Stumpf. We are grateful to him for diligence and care in trapping, collecting, and preparation of field observational records.

Observations

The numbers and kinds of the more commonly collected hosts are shown in Table I. Other hosts less commonly collected are California white-footed mouse, *Peromyscus californicus;* brush rabbit, *Sylvilagus bachmani;* shrew, *Sorex vagrans;* wood rat, *Neotoma fuscipes;* spotted towhee, *Papilio erythrophthalmus;* brown towhee, *P. fuscus;* Bewick wren, *Thryomanes bewickii;* California jay, *Aphelocoma coerulescens;* white-crowned sparrow, *Zonotrichia leucophrys;* alligator lizard, *Gerrhonotus multicarinatus* and the fence lizard *Sceloporus occidentalis*. California ground squirrels, *Citellus beecheyi*, were absent. They originally occupied the area, but have been eliminated by a concentrated poisoning program.

Table I: Number of mice and lizards examined and tabulated by month during the season when ticks were active.

	Mar	April	May	June	July	Aug	Sept	Oct	Total
Harvest mice	10	15	5	8	5	10	17	0	70
Deer mice	14	9	1	42	23	20	30	0	139
Meadow mice	49	53	30	79	113	108	153	145	730
Alligator lizards	0	1	4	6	0	0	1	1	13
Fence lizards	1	4	0	4	0	12	15	1	37

Table II shows a monthly record of tick infestation from March through October as found on the meadow mouse.

Nymphs of *Ixodes angustus* were found on one meadow mouse and one harvest mouse.

Ixodes spinipalpis was found on the California jay, spotted towhee, meadow mouse, deer mouse, and the brush rabbit as follows: One larva on a deer mouse, 1 June; five on brush rabbits between 27 June and 14 July; and three on the spotted towhee, 4 August.

Table II: Records of ticks (all species) from meadow mice: per cent of hosts infested, numbers examined and per cent of ticks which were nymphs and larvae.

	Mar	Apr	May	June	July	Aug	Sept	Oct	Average or Total
Per cent mice infested	2	9	17	39	27	34	21	0.7	18.7
Aver. per infested mouse*	1.0	2.8	1.4	3.2+	4.2	11+	2.1+	6.0	3.9+
Greatest no. per mouse*	1.0	10	3	11	21	49	14	6	14.3
Per cent nymphs	100	76	23	7	43	36	57	14	44.5
Per cent larvae	0	24	77	93	54	64	43	86	55.1
Nrs. hosts examined	49	53	30	79	113	108	153	145	730.0
Nrs. ticks identified	1	7	7	74	141	268	52	7	557.0

*Excluding counts on 3 mice in June, 2 in August and 1 in September on which ticks were so numerous or hidden in the ears as to preclude a complete count. The largest count (49) was made in August from a mouse killed and brought to the laboratory.

Nymphs were collected from the California jay and meadow mice, 20 March through 14 July. Adults were found on brush rabbits between 25 May and 20 June.

Ixodes pacificus was the only species of tick found on the fence and alligator lizards. Larvae were collected 4 August to 20 September; nymphs from 7 April to 28 June; some adults were collected 27 June. Larvae and nymphs were found on meadow mice, larvae only on harvest mice, deer mice, and a shrew. The adult specimens were from alligator lizards, man, and horses. The peak of population occurred in June. Only 0.4 percent of the 557 ticks removed for identification from meadow mice were this species.

Haemaphysalis leporispalustris were commonly encountered on brush rabbits as larvae, nymphs, and adults. Larvae and nymphs also were found on the spotted and brown towhees and the Bewick wren.

Larval *Dermacentor occidentalis* were observed on meadow mice, harvest mice, deer mice, California white-footed mice, and the brush rabbit. The first larvae were observed on 23 April and the latest on 10 October. The first nymph observed was on 31 March, and the last nymphal collection was on 4 October. *D. occidentalis* was the most common tick taken from the meadow mice. It constituted 99 per cent of the sample of 557 ticks taken from *Microtus* for identification. This is shown in Table II. A peak population on meadow mice was indicated for July and August. In July, 19 per cent of the meadow mice bore larvae and 20 per cent bore nymphs, and in August, 20 per cent bore larvae and 23 per cent bore nymphs. During this same period, 8 per cent of the harvest mice and 11 per cent of the deer mice were infested. All of the brush rabbits examined were infested.

Discussion

Ixodes angustus: According to Gregson (1956) this "is the commonest species of tick on British Columbian coast squirrels, *Tamiasciurus douglasi mollipilosus*," and "one of the commonest species of *Ixodes* in British Columbia." It is surprising in our studies to have only collected larvae, and these only from one meadow and one harvest mouse. Adults and nymphs as observed by Bishop and Trembley (1945), and Cooley and Kohls (1945) showed them to appear a score or more of times on other rodents and shrews in the studied localities. It is presumed that the kind of habitat and possibly the fact that some key hosts were not collected may be partly responsible for the scarcity in numbers of individuals and other developmental stages. Ground squirrels were virtually absent and wood rats rarely entered the study area. Lagomorpha have not been listed as hosts.

Ixodes spinipalpis was found in larval and nymphal development on a variety of hosts. There seemed to be no restriction of the larvae and nymphs to smaller hosts for larvae were found on both brush rabbits and deer mice. Adults however were found only on the brush rabbit.

Ixodes pacificus has been commonly collected in the larval and nymphal stages from the alligator lizard along the Pacific coastal region (Cooley and Kohls, 1945; Gregson, 1956). It was natural to find it infesting this and the fence lizard at the San Mateo locale. It is however interesting that in studies by Beck (1955), Allred, Beck, and White (1960) for Utah, Beck, Allred, and Brinton (1963) for Nevada, this species was not found on any species of lizard. It also was uncommon on mice in our study.

Our collections indicate the larvae and nymphs tend to occur mostly on small mammals and lizards. Larger and medium-sized mammals, and lizards are most often reported hosts of adults (Cooley and Kohls, 1945), and (Bishop and Trembley, 1945). However, it is interesting to note in the observations by Linsdale and Tevis (1951) in their study of the dusky-footed wood rat made at a location about eighty miles south of our location that, "In Monterey County, 11 per cent of the wood rats *Neotoma fuscipes* were infested by larval *Ixodes pacificus* at the height of the season (in May). One was infested by a nymph. In August, 14 per cent were infested by nymphs and larvae of *Dermacentor occidentalis*."

Although our sample of specimens is too small to be conclusive, there did seem to be a greater tendency for *I. pacificus* to infest cricetine mice compared to meadow mice. Seventeen per cent of 193 ticks identified from 209 cricetine mice were this species. From a general review of the literature and our observations in the present study, one could postulate that host association of ticks in San Mateo County is related to choice of habitat by the mice: the cricetine species occur most commonly in open areas inhabited by fence lizards and the microtine under heavy vegetative cover and at a higher humidity. There is evidence also that the size of a host's home range

effects the percentage infested by certain ticks and other ectoparasites (Mohr and Stumpf, 1962).

According to Cooley (1946), Beck (1955), and Gregson (1956) adult *Haemaphysalis leporispalustris* are predominantly parasites of brush rabbits, cotton tails, and other rabbits and hares. Larvae and nymphs occur on rabbits, and ground-inhabiting birds for which Bishop and Trembley (1945), Peters (1936), and Nibley (1962) report almost 100 species. Larvae were found on the Bewick wren and larvae and nymphs on the spotted and brown towhees. It is not uncommon to find the larval, nymphal, and adult stages at the same time on a single lagomorph host (Green et al, 1943; Beck, 1955; and Gregson, 1956). In our study, the brush rabbit was the only leporid observed. In all instances, they were heavily infested by all developmental stages.

Dermacentor occidentalis: Our observations show this species of tick to have its highest seasonal population in the San Mateo study area during August. It was the most abundant of the tick species observed in the area. No adult ticks were found on the rodents examined. Adults commonly attack the larger vertebrates such as ungulates, dogs, and man (Cooley, 1938; Bishop and Trembley, 1945).

Conclusions

Five species of ticks were found on the reptiles, birds, and mammals in a small study area of approximately two acres. *Dermacentor occidentalis* was the most common of the ticks observed. Its peak population of larvae occurred about June when 39 per cent of the meadow mice were infested; and of nymphs in August when 34 per cent of these mice were infested. *Ixodes pacificus* was the only species found on reptiles. Larvae and nymphs were also collected from a small percentage of meadow mice and others. Adults of *Haemaphysalis leporispalustris* were found only on the brush rabbits and ground-inhabiting birds. A few *Ixodes angustus* were found on mice, and *I. spinipalpis* on birds, mice and rabbits.

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ALYSSUM TURGIDUM: A NEW SPECIES FROM IRAN

T. R. Dudley[1]

An extremely interesting gathering of *Alyssum* was found in a collection of specimens sent to the author for identification and study by Dr. K. H. Rechinger of the Naturhistorisches Museum, Vienna, Austria. No specimen, possessing the very distinctive, inflated and turgid fruits, such as are diagnostic for the species described below, were discovered in any of the numerous European herbaria that have been visited by the author. This species, assigned to sect. *Odontarrhena* (Meyer) Koch, was apparently unknown to E. J. Nyárády, the monographer of this section. Likewise, as it was not mentioned or described in Parsa's more recent *Flore de l'Iran*, it probably had not been collected prior to 1961. In that year, Dr. Howard C. Stutz of the Brigham Young University, Provo, Utah, U.S.A., made the original collection. The author is indebted to Dr. Stutz for making the holotype available.

Alyssum turgidum Dudley, sp. nov.

Figs. A-E, G-K.

Holotype. Iran. Japarabad, dry south slopes, 5000 ft., 17 May 1961, *Stutz 1289* (BRY); isotype (W).

In Sectione *Odontarrhena* (Meyer) Koch siliculis globosis valde inflatis turgidis utriculiformis insignis. Ceterum ad. *A. kaussknechtii* Boiss. accedens sed illa species fructibus maioribus et formae valde diverso, sepalis et petalis minoribus, indumento parciore et pilis stellatis minoribus inter alia distinguitur.

Planta perennis, suffrutescens, basi multiramosa, 7-15 mm. lata, 5-10 cm. alta, ex toto indumento dense cinereo, e pilis stellatis appressis minute punctatis 4-6 radiatis radiis ramosis aequalibus 0.3-0.6 mm. diametro composito. *Caules floriferi* tenue, laxe ascendentes vel patentes, 5-15 cm. longi, a basi indumento albo denso tecti vel rubro-purpurei cum pilis stellatis facilis disjunctis. *Surculi steriles* basi caulium floriferorum conferti vel patentes, (0.5-)1.5-3(-5) cm. longi. *Folia caulium floriferorum* oblanceolata vel spatulata, post anthesin decidua, acuta, 7-15 mm. longa, 2-3 mm. lata. *Folia surculorum sterilium* obovato-spatulata, 2-10 mm. longa, 2-3 mm. lata. *Corymbi* ramosi, constricti, 1-3 cm. longi latique. *Pedicelli* rigidi, divergentes vel horizontales, 2.5-4.5 mm. longi. *Sepala* decidua, membranacea, ad apicem cucullata, ovata, obtusa, anguste hyalino-marginata, 1.5-2 mm. longa, 0.5-1 mm. lata, pilis stellatis sparsis provisa. *Petala* clavata vel obovata, integra vel subretusa, in unguem

1. The Arnold Arboretum, Harvard University, Jamaica Plain 30, Mass.

sensim attenuata, glabra, 2-2.5 mm. longa, 1-1.5 mm. lata. *Filamenta longa*, 2-2.5 mm. ala unilaterali in dimidio inferiore connata, apice libero acuto vel 1-2- denticulato. *Filamenta brevia*, 1.5-2 mm., appendice libera, oblanceolata, bifida, ca. 1. mm. longa praedita. *Stylus* 1-1.5 mm. longus, tenuis sed rigidus, in dimidio inferiore pilis stellatis minutis provisus. *Silicula* orbiculata vel oblata, globosa, magno turgida, utriculiformo-tumida, (3-)4-6 mm. longa et lata, valvis bene aequaliter inflatis, indumento sparse vel copiose provisis. *Ovulum* unum per loculum. *Semen* immaturum, ut videtur alatum. Fl. Apr.-May, fr. May-June.

From among the taxa allocated to sect. *Odontarrhena* (subsect. *Inflata*). *Alyssum turgidum* appears to be most closely allied to *A. haussknechtii* Boiss., a rare alpine endemic found only in the Anti-Taurus region of southern Turkey [Holotype, Turkey, C6: Prov. Maras, in rupestribus alpinis montis Berytdagh (Berit dagg) Cataoniae, 2844-3160 m., 10 Aug. 1865, *Haussknecht s.n.* (G); isotypes (BM, W)]. The fruit of *A. turgidum*, like that of *A. haussknechtii* has an orbicular medial cross-section. This is caused by the valves being strongly inflated. The tapered, conical and smaller fruit of *A. haussknechtii*, however, is inflated to its maximum extent only at its center (Pl. I, fig. F). A cross-section of a fruit of *A. haussknechtii* from above the middle point is not orbicular, but is transversely elliptic. In contrast, the valves of *A. turgidum* are completely inflated; the fruit being turgid and spherical, and a cross-section at any point is orbicular. The characters of a short stipe supporting the fruit and saccate valves are common to both species, but are not as prominent in *A. turgidum*.

The different type of indumentum on the fruits of these related species is also of distinguishing value. The stellate hairs which comprise the dense silvery white indumentum on the fruits of *Alyssum haussknechtii* are often twice the size and possess twice as many rays as the sparser hairs on the fruits of *A. turgidum*. As the fruits of *A. haussknechtii* mature, their indumentum is readily displaced. This phenomenon is not noticeable in *A. turgidum*. Though the shape of the sepals and petals, and the filament wings and appendages of these two species are similar, those of *A. haussknechtii* are always considerably larger.

In addition to the characters mentioned in the Latin diagnosis, *Alyssum turgidum* can be distinguished from *A. haussknechtii* by several others. The styles of *A. turgidum*, though as long as those of *A. haussknechtii*, are slender and tapered, with the basal and apical diameters being more or less equal. On the other hand, the styles of *A. haussknechtii* are strongly dilated towards their bases, and with the basal diameter two to three times as great as the apical. The inflorescence of both species is congested, but that of *A. turgidum* is branched and corymbose. The pyramidal inflorescence of *A. haussknechtii* is seldom branched and resembles that of a number of annual species in sect. *Alyssum*, such as *A. szowitsianum* Fisch. & Mey. and *A. marginatum* Steud. ex Boiss. In habit *A. turgidum* and

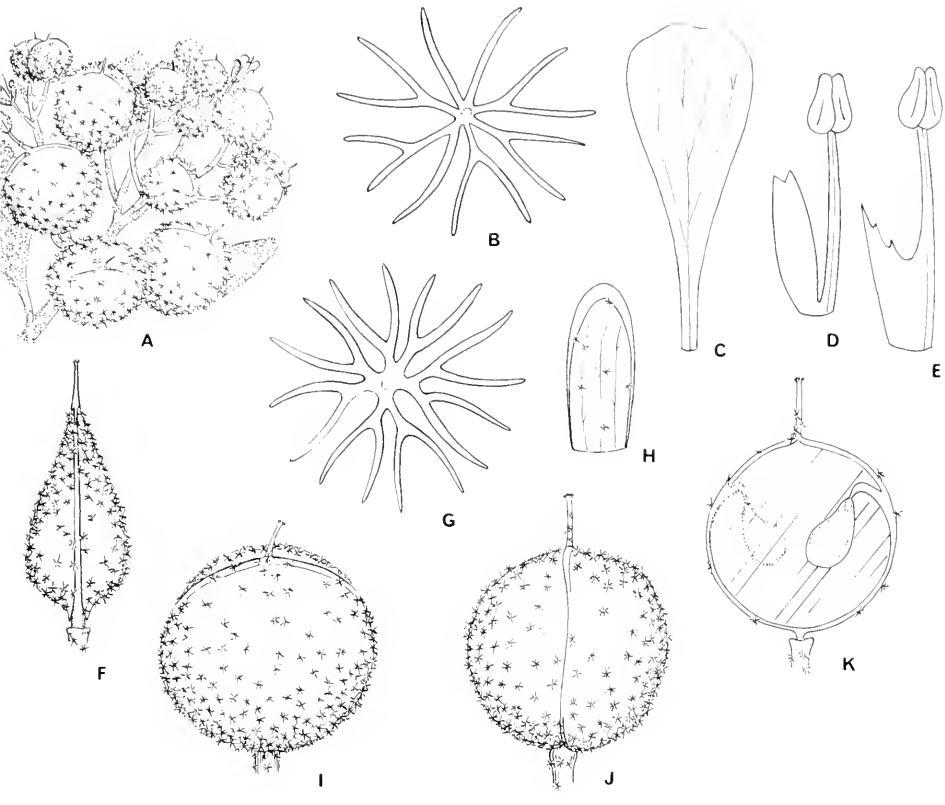

PLATE I

A-E, G-K - *Alyssum turgidum* Dudley. A, fruiting inflorescence, X 4.5. B, stellate hair from fruit, X 165. C, petal, X 30. D, short filament, X 27. E, long filament, X 27. G, stellate hair from stem, X 100. H, sepal, X 15. I, ventral view of fruit, X 10. J, lateral view of fruit, X 10. K, view of fruit with valves removed to show ovules, X 10.
F, *A. haussknechtii* Boiss. Lateral view of fruit, X 10.

A. haussknechtii are somewhat similar, and both taxa could be assigned to Nyárády's artificial group. the "Humiliores" (1929 & 1949). As a general rule, however, the plants of *A. haussknechtii* are more pulvinate with shorter and strict flowering stems. The flowering stems of mature individuals of *A. turgidum* are laxly ascending or sprawling in a decumbent manner. Nyárády omitted *A. haussknechtii* from his earlier systematic treatments of the taxa in sect. *Odontarrhena* (1926-1929) because he had not seen any material of it, but he did incorporate it as a component of his "Humiliores" in his diagnostic key (1929) and in his *Synopsis*. . . of 1949.

In the first supplement of *Florae Keredjensis*. . . (Repert. Sp. Nov. 40:253, tab. 238a. 1940.) Bornmüller & Gauba described a single gathering collected by Gauba in North Iran as *Alyssum nyaradyri* [Holotype, North Iran, An sehr heissen pflanzenarmen Hängen des südlich von Keredj in der Steppe gelegenen Sefidkuh, bei 1400 m., sehr selten, 1 June 1937. *Gauba 1374* (B-Herb. Bornmüller) - a fragment of this gathering given to Nyárády by Bornmüller].

The diagnosis of *Alyssum nyaradyi* (altered by Bornmüller in 1941 to nyárádii) allies it to *A. haussknechtii*, the same species to which *A. turgidum* is related. *Alyssum nyaradyi* is said to differ from *A. haussknechtii* by having subinflated and orbicular fruits. The original description of *A. nyaradyi* reads: "siculis orbicularibus, subvesiculoso-tumidis, 2 mm. diametricis. . . ." Nyárády comments in a note in the second supplement of *Florae Keredjensis*. . . (Repert. Sp. Nov. 50: 372. 1941.) that the densely congested, very small, swollen and roundish fruits characterized *A. nyaradyi* as a well defined new species. Although the original specimen of *A. nyaradyi* has not been examined by the present author, its description and diagnosis (which state that the fruits are only subinflated, subvesiculate and are only 2 mm. in diameter), permit the conclusion that it and *A. turgidum* are not conspecific. The fruits of the latter species are always utriculate, very strongly inflated and 2-3 times larger than those of *A. nyaradyi*.

In addition to the different types of fruit characteristics of these two species, a number of other obvious characters can be readily observed when the type description and habit photograph of *Alyssum nyaradyi* are compared with the type specimens of *A. turgidum*. The very woody caudex characteristic of *A. nyaradyi* is not well developed in the suffrutescent *A. turgidum*. The flowering stems of the latter are lax and usually decumbent, but those of *A. nyaradyi* are strict and generally erect (as in *A. haussknechtii*). The leaves of the flowering stems and sterile shoots of *A. nyaradyi*, judging from the measurements given by Bornmüller, are apparently always smaller by half than those of *A. turgidum*. Bornmüller described the pedicels of *A. nyaradyi* as being only 0.5 mm. long. The mature pedicels of *A. turgidium* consistently measure 2.5-4.5 mm. long, and its styles, which always have an indumentum, are 1-1.5 mm. long.

Whether *Alyssum nyaradyi* should be maintained as a distinct species must be left in abeyance until the original Gauba specimen is examined.[2] However, a single specimen collected by Gauba (No. 148) from the exact type locality of *A. nyaradyi* is to be found in the herbarium of the Naturhistorisches Museum, Vienna (W). This sheet, unfortunately, (determined by Nyárády is *A. nyaradyi*) was not furnished with any data as to the date of collection. The floral

2. Though the original set of Bornmüller's own New Eastern collections was deposited by him in the Ifaussenknecht herbarium in Jena, he sold his original herbarium (which probably contained the type of *Alyssum nyaradyi*) to the Botanical Museum at Berlin. As the single specimen of *A. nyaradyi*, which constitutes the type, cannot be located either in Jena or in Berlin, it is assumed that it was destroyed in the disastrous fire in the Berlin Museum in 1943.

and fruit (immature) characters of this plant permit it to be positively identified as *A. inflatum* Nyár., a species very distinct from *A. turgidum*. Furthermore, a number of additional collections of *A. inflatum* have been made from the type locality of *A. nyaradyi*.

Dr. Stutz recalled to the author (in correspondence) that *Alyssum turgidum* and a species of *Pedicularis* were abundant on the barren slopes of the collection site, and that they composed most of the green vegetation at that time of year (i.e., May).

Other species of *Alyssum* collected in the year of 1961 in Iran by Dr. Howard C. Stutz; specimens in the Brigham Young University Herbarium (BRY).

A. bracteatum Boiss. & Buhse; 30 miles W. of Quom, sterile volcanic soil, 5200 ft., 5 May 1961, *Stutz 1042*.

A. desertorum Stapf; 10 km. W of Kiraj, west facing slope, gravelly surface, clay below, ca. 5000 ft., 22 April 1961, *Stutz 675*.

A. stapfii Vierh.; 10 km. W of Kiraj, west facing slope, gravelly surface, clay below, ca. 5000 ft., 22 April 1961, *Stutz 679*.

A. szowitsianum Fischer & Meyer; 10 km. W of Kiraj, west facing slope, gravelly surface, clay below, ca. 5000 ft., 22 April 1961, *Stutz 676*.

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A NEW SPECIES OF CHIGGER (ACARINA, TROMBICULIDAE) FROM LIZARDS OF WESTERN NORTH AMERICA

Richard B. Loomis[1]

Studies of the chiggers taken from lizards in southwestern United States and northwestern Mexico revealed a new species of chigger which seems to be related to *Trombicula allredi* Brennan and Beck (1956). These larvae have been found only on lizards from the desert areas of Sonora, Mexico, California and Nevada. It was reported from Nevada as *Trombicula* sp. by Allred and Beck (1962:50).

Grateful acknowledgement is extended to many individuals who have generously provided chiggers, including Dr. Dorald M. Allred, Brigham Young University (BYU) and Dr. James M. Brennan, Rocky Mountain Laboratory for the slides from Nye County, Nevada; Alan R. Hardy for the larvae from Clark County, Nevada; and Julius C. Geest, Kenneth D. Peyton and William J. Wrenn for many specimens from California and Mexico. Mr. Geest completed the drawings. Chiggers from Joshua Tree National Monument, California, were taken in the faunal surveys approved by Superintendent William R. Supernaugh.

The studies upon which this paper is based were supported by a research grant AI-3407 from the National Institutes of Health to Long Beach State College.

Description of the Species

The specimens listed below are larvae, and are in the collection of the author, unless otherwise noted. All measurements are in microns. The terminology follows that of Warton, *et al* (1951), except for the use of tarsala (=spur) and microtarsala (=microspur).

Trombicula lacerticola, new species

(Figure 1)

Types.—Holotype and 17 paratopotypes from Cottonwood Spring, Joshua Tree National Monument, Riverside County, California, from *Uta stansburiana* Baird and Girard, Side-blotched Lizard, field number WJW610711-3, taken on 11 July 1961 by William J. Wrenn; and 7 paratopotypes from *Sceloporus magister* and *Uta stansburiana*, 11-12 July 1961 (4 larvae) and 6 August 1959 (3 larvae). The holotype and two paratypes will be deposited in the Rocky Mountain Laboratory, Hamilton, Montana, and paratypes will be distributed to the United States National Museum; the University of Kansas; Hooper Foundation, University of California Medical Center, San Francisco, and to other appropriate institutions and individuals.

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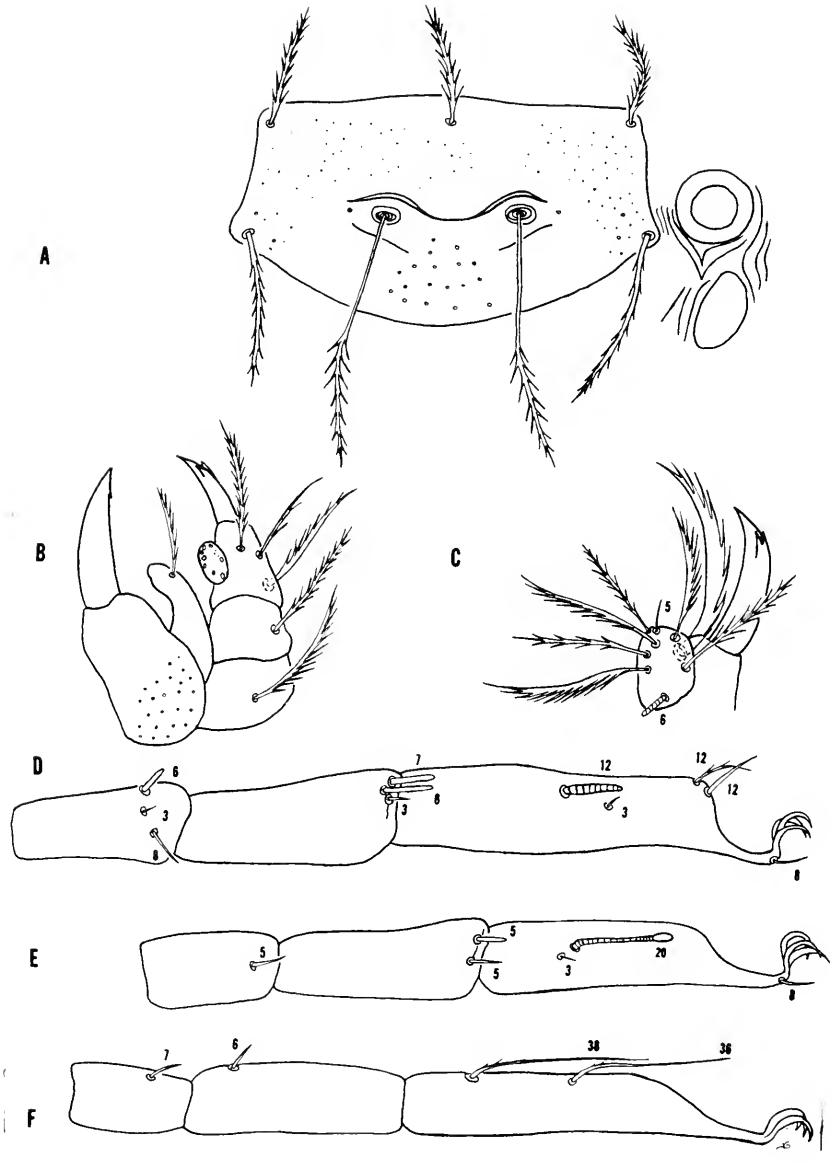

Figure 1

Trombicula lacerticola new species

A. Scutum and eyes.
B. Gnathosoma, dorsal aspect.
C. Palpal tarsus and palpal claw.
D. Leg I showing nude and specialized setae (numbers refer to measurements in microns).
E. Leg II showing nude setae.
F. Leg III showing specialized setae.

DIAGNOSIS.—Related to *Trombicula allredi* Brennan and Beck in having two mastitarsalae (with few basal barbs), elongate legs, branched sensillae, trifurcate palpal claw, scutum punctate with posterior margin convex, and parasubterminala branched; differing from this species in having palpal tarsal setal formula 7 B.S. (6 B.S. in *T. allredi*), two genualae I (three genualae I in *T. allredi*) and a distinct knob on tarsala II.

DESCRIPTION OF HOLOTYPE.—Body: Partly engorged, approximately 210 by 320, color in life orange; eyes 2/2, anterior larger, red in life, ocular plate indistinct.

Dorsal setal formula 2-6-6-4-2, total 20; humeral seta measuring 29, seta of first posthumeral row 24.

Ventral setal formula 2—2 +26, total 30, first sternal seta measuring 26, posterior ventral seta 21.

Scutum: Shape subpentagonal, with rounded posterior margin and numerous puncta (see Figure 1A). Sensillary bases parallel to bases of PL's. Sensillae with approximately 14 branches on distal half.

Scutal measurements of holotype, AW-58, PW-68, SB-18, ASB-21, PSB-18, AP-19, AM-19, AL-21, PL-28, S-51. Mean and extremes of 10 larvae (5 paratopotypes and 5 larvae from Guaymas, Sonora, Mexico): AW-59 (55-62), PW-70 (66-72), SB-18.5 (17-20), ASB-22.5 (20-24), PSB-17 (13-19), AP-19 (17-21), AM-18 (17-19), AL-19 (15-23), PL-26 (23-30) and S-53 (49-55).

Gnathosoma: Cheliceral blade with dorsal tricuspid cap and prominent ventral tooth; cheliceral base and capitular sternum punctate. Galeal seta branched. Palpal setal formula B/B/BBB; palpal tarsus with 7 branched setae, subterminala and tarsala (6 microns); palpal claw trifurcate.

Legs (specialized setae as follows): Leg I with 2 genualae, microgenuala, 2 tibialae, microtibiala, tarsala (12 microns), microtarsala, subterminala, parasubterminala branched, and pretarsala; leg II with genuala, 2 tibialae, tarsala (16 microns), with knob, microtarsala and pretarsala; leg III with genuala, tibiala and 2 mastitarsalae having several basal barbs. All legs with segments elongate and punctate, with each leg terminating in 2 claws and a clawlike empodium (Figure 1D-F).

REMARKS.—The generic allocation of *lacerticola* to *Trombicula* is tentative, as it is not *Trombicula, sensu stricto.* This species does not seem to belong to the genus *Neotrombiculoides* Vercammen-Grandjean (1960), nor to the subgenus *Squamicola* Audy and Vercammen-Grandjean (1961) currently placed in the genus *Eutrombicula.* The palpal tarsal setal formula of *lacerticola* is 7 B.S., which differs from that reported for *Neotrombiculoides* (7 B. or 6 B.S.) and although the palpal formula is the same as that of *Squamicola*, *lacerticola* has only two genualae (three genualae in *Squamicola*) in addition to other differences. The 13 species of *Squamicola* (including *Eutrombicula maura* Taufflieb and *E. meridialis* Taufflieb,

1960) have been found only in Africa, and with the exception of one species, they have been recovered only from lizards. These species of *Squamicola* and *T. lacerticola* possess an expanded tip on tarsala II, which may indicate close relationship; however, at least four other species of chiggers, including two species in another subfamily, also possess this modification. These species are *Odontacarus arizonensis* (Ewing) from North American lizards and *Odontacarus agamae* Taufflieb (1960) from North African lizards, in subfamily Leeuwenhoekiinae, and *Euschoengastia longitarsala* Powder and Loomis (1962) taken only from lizards in California and *Sauriscus ewingi* Lawrence from South African lizards. The genus *Sauriscus* was discussed by Audy and Veracammen-Grandjean (1961:138) who state that "This chigger is obviously derived from the same stem as *Squamicola* and indeed might well be regarded as a sister subgenus." It is suggested that the expanded tip of this chemoreceptor plays a role in the detection of the lizard hosts.

Nymphs and adults of *T. lacerticola* have been reared and will be studied and described in detail. Comparison of the postlarval stages of this species and members of *Squamicola* should help to determine if they have a close relationship.

The larvae of this species were found attached in the axillary and groin areas, and in the "mite pockets" which are located above the front limbs of the saurian hosts.

The seasonal occurrence of the attached larvae seems to be limited to the summer months, as most of the records are between the first of June and the end of August. Many of the records from California were from lizards taken in or near rocky habitats.

Specimens Examined.—Total 197 larvae as follows: NEVADA. Clark County: 3 mi. SE Riverside on Virgin River, 4 August 1961, *Uta stansburiana* (10) and *Sceloporus magister* (4). Nye County: 14 to 30 mi. N Mercury, 26 August 1959, *Cnemidophorus tigris* (1-BYU), *Crotaphytus wislizeni* (1-BYU) and *Phrynosoma platyrhinos* (1-BYU), 6 Sept. 1959, *Uta stansburiana* (2-BYU). CALIFORNIA. Kern County: Ridgecrest, 30 June 1957, *Callisaurus draconoides* (5). Riverside County: Snow Creek Canyon, 14 June 1961, *Uta stansburiana* (5); 1.7 mi. N of Joshua Tree National Monument Entrance on Old Dale Road, 4 June 1961, *Crotaphytus collaris* (2); (all of the following localities in Joshua Tree National Monument)—Belle Campground, 3800', 5 Aug. 1959, *Sceloporus magister* (11); Cottonwood Spring, 11-12 July 1961, *Sceloporus magister* (4) and *Uta stansburiana* (18, including type series); and 6 August 1959, *Uta stansburiana* (3); Lost Horse Valley, 4200', 19-22 July 1961, *Crotaphytus wislizeni* (8), *Sceloporus occidentalis* (3) and *Uta stansburiana* (20); 6 August 1959, *Sceloporus occidentalis* (2); 6 mi. NW Old Dale Junction 2400', 30 May 1960, *Uta stansubriana* (4); Piñon Wells, 3900', 7 August 1959, *Uta stansburiana* (9); Squaw Tank, 3700', 7 August 1959, *Uta stansburiana* (1); Queens Valley, 2 July 1960, *Phrynosoma platyrhinos* (2); 4 mi. S, 1 mi. E Squaw Tank, 6 August 1959, *Sceloporus magister*

(3). San Bernardino County: (all in Joshua Tree National Monument)—49 Palms road, 0.6 mi. SW of Monument Entrance, 5 August 1961, *Crotaphytus collaris* (8); 4 mi. S Twentynine Palms, 0.3 mi. S Monument Entrance, 11 July 1961, *Crotaphytus wislizeni* (3). MEXICO. Sonora, 9-11 mi. NW Guaymas, 4-6 July 1960, *Callisaurus draconoides* (28) *Uta taylori* (2) and *Urosaurus ornatus* (8), 9 June 1961, *Crotaphytus collaris* (18) and *Holbrookia maculata* (11).

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UNDESCRIBED SPECIES OF NEARCTIC TIPULIDAE (DIPTERA) IV.

Charles P. Alexander[1]

All species discussed at this time are from California where they were collected by Dr. Dennis Hynes, Mr. Hugh B. Leech and the present writer, the types being preserved in my collection except where indicated to the contrary. I am indebted to the other collectors for their continued interest in making known the rich Tipulid fauna of California.

Tipula (*Lunatipula*) *cladacanthodes*, n.sp.

Allied to *cladacantha*, differing chiefly in the hypopygial characters, especially the tergite and inner dististyle, the outer basal lobe of the latter with its anterior arm slender, posterior arm short, the apical points strongly divergent.

Male.—Length about 17 mm.; wing 18 mm.; antenna about 6 mm.

Frontal prolongation of head subequal in length to the remainder, yellow; nasus small but distinct; palpi yellow, terminal segment brownish black. Antennae relatively long; basal three segments yellow, remainder brownish black, the basal enlargements slightly darker, especially on the outer segments; verticils shorter than the segments. Head buffy brown, more yellowed behind and surrounding the antennal bases; vertex with a capillary blackish median line.

Thoracic dorsum almost uniformly yellow, the usual praescutal stripes faintly differentiated. Pleura yellowed, vaguely patterned with darker yellow areas; dorsopleural membrane clear yellow. Halteres with stem yellow, knob dark brown. Legs with coxae and trochanters orange yellow; femora brownish yellow, tips darker brown; tibiae and basitarsi yellowish brown, remainder of tarsi darker; claws toothed. Wings brownish yellow, prearcular field, costal region and stigma slightly darker, proximal end of the last more yellowed; obliterative band before cord extensive; veins brownish yellow. Venation: Petiole of cell M_1 slightly exceeding *m*.

Abdomen chiefly yellowed, midregion of tergites slightly more infuscated; hypopygium yellow. Male hypopygium generally as in *cladacantha*, including the bifid outer basal lobe of the inner dististyle, differing in all details of structure. Tergal lobes more obtusely rounded at apices. Inner dististyle with main body narrower; outer basal lobe distinctive, the anterior arm slender, almost parallel-sided, posterior arm shorter and diverging more strongly from body of style the apical points likewise strongly divergent.

Habitat.—California (Monterey County).

1. Amherst, Massachusetts.

Holotype. ♂, Spruce Creek, June 25, 1962 (Dennis Hynes); Hynes No. 72.

The most similar species is *Tipula* (*Lunatipula*) *cladacantha* Alexander, of the Sierra Nevadas, California, which differs in the hypopygial characters, as discussed above.

Thaumastoptera hynesi, n.sp.

Size small (wing of male 4.5 mm.); general coloration of body, halteres and legs yellow; wings pale yellow, the inconspicuous veins slightly darker yellow; male hypopygium with the outer dististyle broad, the beak with a powerful seta on disk.

Male.—Length about 3.8 mm.; wing 4.5 mm.; antenna about 1.2 mm.

Rostrum light yellow, palpi brown. Antenna with scape and pedicel yellow, flagellum dark brown; flagellar segments oval, shorter than their verticils. Head obscure yellow, the broad anterior vertex light silvery.

Thorax fulvous yellow, subnitidous; notal vestiture whitened. Halteres with stem white, knob more yellowed. Legs yellowish white throughout; claws long and slender, gently curved, simple. Wings pale yellow; veins inconspicuous, slightly darker yellow; macrotrichia dark brown. Longitudinal veins with numerous trichia, lacking on bases of veins *M*, *Cu* and Anals. Venation: *h* faintly indicated; Sc_1 ending about opposite three-fourths *Rs;* vein R_2 long, very pale and without trichia, close to top of R_1; vein Sc_2 also very pale, apparently far retracted and lying basad of origin of *Rs;* branches of *Rs* gently decurved, convergent outwardly, cell R_3 at margin narrower than cell R_5; petiole of cell *2nd* M_2 only a little longer than the basal section of M_{1+2}; *m-cu* nearly opposite midlength of *Rs*.

Abdomen, including hypopygium, light yellow. Male hypopygium with the tergal region at midwidth with a dense concentration of pale setae and setoid points, these directed mesad to form a compact median pocket. Basistyle with setae at apex of outer face very long, exceeding the dististyle in length. Dististyle terminal, broad, the outer crest obtusely rounded; beak developed, bearing a single powerful seta on disk, with additional more basal marginal setae, including a concentration of larger bristles near base. Phallosome including the simple sclerotized aedeagus arising from a basal sheath, thence slightly dilated, very gradually narrowed and curved to the acute tip.

Habitat.—California (Monterey County).

Holotype. ♂, Spruce Creek, June 25, 1962 (Dennis Hynes); Hynes No. 70.

I take unusual pleasure in naming this outstanding fly for Dr. Dennis Hynes, who is accomplishing fine work on the biology of the California Tipulidae. This is a noteworthy discovery. The inconspicuous small fly furnishes the first record of occurrence of the

genus in the New World. The six species previously described are from Europe, the Philippines, South India, southeastern Africa, and Madagascar. Two further species are known as Tertiary fossils in the Gurnet Bay beds and from the Baltic Amber.

Dicranota (*Plectromyia*) *lassenensis*, n.sp.

General coloration of head and thorax dark gray, the praescutum with three slightly differentiated grayish brown stripes; femora obscure yellow, the tips narrowly more darkened; wings narrow, subhyaline, stigma pale brown; veins brown, conspicuous against the ground; male hypopygium with the median lobe of tergite very low; dististyle large and tumid, darkened, broadly oval in outline.

MALE.—Length about 4.8 - 5 mm.; wing 5.4 - 6 mm.; antenna about 0.6 - 0.7 mm.

FEMALE.—Length about 6 - 6.2 mm.; wing 6.2 - 6.5 mm.

Rostrum and palpi black. Antennae short, 13-segmented, brownish black throughout; basal flagellar segments long-oval, outer ones shorter, the segments less than their verticils. Head gray, posterior vertex variegated by brown areas on either side of midline.

Thorax dark gray, praescutum with three slightly differentiated grayish brown stripes. Pleura dark gray, dorsopleural membrane dusky. Halteres with stem yellow, knob infuscated. Legs with coxae yellowed, fore pair more darkened basally; femora obscure yellow, tips narrowly and vaguely more darkened; tibiae and tarsi yellowish brown, outer tarsal segments darker. Wings narrow, subhyaline, stigma oval, pale brown, base more yellowed; veins brown, conspicuous against the ground, prearcular veins yellowed. Longitudinal veins beyond cord chiefly with macrotrichia, lacking on R_{2+3+4}; basad of cord lacking on *M*, present on outer ends of Cu_1 and the Anals. Venation: R_2 in cases very close to tip of R_1, R_{1+2} shorter than R_2; R_{2+3+4} variable in length, from subequal to *r-m* to twice this length; *Rs* arcuate to subangulate at near midlength; *m-cu* about one-third to one-half its length beyond the fork of *M*.

Abdomen, including hypopygium, brownish gray, the latter large. Ovipositor with cerci horn yellow, hypovalvae paler. Male hypopygium with the median tergal area slightly produced to appear low convex in outline; each lateral arm produced into a long terminal spine. Interbase broadly expanded at near midlength, the apical spine slender. Dististyle very large and tumid, darkened, broadly oval in outline, outer face virtually glabrous, apex with a few elongate setae.

HABITAT.—California (Shasta County).

HOLOTYPE, ♂, Reflection Lake, Lassen Volcanic National Park, 5890 feet, August 5, 1958 (Alexander). ALLOTYPE, ♀, pinned with type PARATOPOTYPES, 5 ♂ ♀, August 3-5, 1958 (Alexander).

Swept from vegetation along small stream flowing into Manzanita Lake opposite Park Headquarters.

The most similar species is *Dicranota* (*Plectromyia*) *cascadica* Alexander, of Oregon and Washington, which is told by the paler buffy brown coloration of the thorax and the details of the male hypopygium, especially the dististyle.

Gonomyia (*Idiocera*) *leechi*, n.sp.

Allied to *multistylata;* thoracic pleura heavily striped longitudinally with brown and yellow; wings conspicuously patterned with dark brown, cell *C* with a series of paler brown spots; veins R_{1+2} and R_3 confluent at margin, closing the cell; male hypopygium with the intermediate dististyle a small slender yellow rod.

Male.—Length about 5.5 - 6 mm. wing 5.5 - 6.5 mm.

Female.—Length about 6 - 7.5 mm.; wing 5.5 - 7 mm.

Described from alcoholic specimens. Rostrum dark brown; palpi black. Antennae with scape yellowed above, dark brown beneath; pedicel chiefly brown, flagellum black, the segments long-oval, subequal to the longest verticils. Head pale, vertex with a narrow dark brown central stripe.

Pronotum yellow, with four narrow brown longitudinal lines, including a lateral pair. Mesonotal praescutum with humeral and lateral areas with isolated yellow spots, disk with four nearly confluent dark stripes; scutum with lobes dark brown, median region yellow with a narrow brown central line; scutellum brown, with a yellow central area; mediotergite darkened on central part, broadly yellow on sides, this including also the dorsal pleurotergite. Pleura yellow, with conspicuous brown longitudinal stripes. Halteres with stem whitened, knob dark brown. Legs with femora obscure yellow, tips narrowly brown; tibiae and basitarsi yellowed, tips more narrowly brownish black, outer tarsal segments blackened. Wings whitish subhyaline, conspicuously patterned with dark brown, including the stigma and smaller spots at *h*, arculus, origin of *Rs*, fork of *Sc*, cord, forks of R_{2+3+4} and *M*, with weaker more or less confluent clouds at end of vein R_3; stigma paler brown; a series of from three to seven small pale brown spots in cell *C*; veins brown, *Sc* and the prearcular veins paler brown. Venation: R_{1+2} and R_3 confluent at margin, closing the cell.

Abdomen dark brown, pleural membrane of proximal segments pale. Male hypopygium with apical lobe of basistyle moderately long. Outer dististyle blackened, profoundly divided, outer arm a gently curved spine, its tip acute; inner arm subequal in length, at near two-thirds the length bent at a right angle into a strong spine, its tip acute, the point of angulation with a small spine; intermediate style a small pale yellow rod, about one-half as long as the arms of the outer style; inner dististyle a broad yellow blade, the apex truncate. Aedeagus slender, the simple slender tip decurved.

Habitat.—California (Mono County).

Holotype, alcoholic ♂, The Hot Springs, 3 miles SSE of Bridgeport, at light, August 11, 1962 (H. B. Leech). Allotype, ♀, with

the type. PARATOPOTYPES, 5 ♂ ♀, with the types. Holotype in the California Academy of Sciences. Associated with *Limonia* (*Dicranomyia*) *brevivena* (Osten Sacken) and *Erioptera* (*Symplecta*) *cana* (Walker).

This species is named in honor of Hugh B. Leech, to whom we are indebted for several species of crane flies from California. It is closest to *Gonomyia* (*Idiocera*) *multistylata* Alexander, of southern Utah, the male hypopygium of which similarly has four dististyles or profound branches. The present fly is readily told by the length and coloration of the intermediate style which in *multistylata* is a long slender blackened spine, subequal in length to the branches of the outer style.

Lipsothrix hynesiana, n.sp.

General coloration of mesonotum obscure yellow with three brown areas, the median stripe divided behind; antennae of male elongate; legs obscure yellow; wings obscure yellow, faintly patterned with light brown; no macrotrichia in wing cells; veins R_{2+3+4}, R_{2+3} and R_3 subequal; cell *1st* M_2 long-rectangular, subequal to vein M_3; male hypopygium with the interbase terminating in a narrow paddlelike blade, its tip obtuse.

MALE.—Length about 9.5 mm.; wing 10 mm.; antenna about 4.1 mm.

Rostrum yellow; palpi brown. Antennae of male elongate, as shown by the measurements; scape and pedicel obscure yellow, flagellum dark brown; flagellar segments elongate-cylindrical, with an abundant erect pubescence and slightly longer verticils that are less than one-third the segments. Head of type as seen from above apparently abnormal in color, gray on the right half, yellow on the left.

Pronotal scutum brown, scutellum light yellow. Mesonotal praescutum obscure yellow, with three brown areas, the median stripe divided behind, lateral areas paler and less evident; scutellum obscure yellow, center of each lobe with a single brown area; scutellum yellow; mediotergite brownish yellow. Pleura yellow, vaguely patterned with brown on anepisternum and ventral sternopleurite. Halteres pale yellow, knob brown. Legs with coxae and trochanters yellow; remainder of legs more obscure yellow, the outer tarsal segments very slightly darker; claws bispinous. Wings obscure yellow, faintly patterned with light brown, including the long stigma, cord and outer end of cell *1st* M_2; veins pale brown, somewhat darker in the clouded areas. No macrotrichia in the wing cells. Venation: Sc_1 ending about opposite two-thirds R_{2+3+4}, the latter straight, subequal to R_{2+3} and R_3; *Rs* long; cell *1st* M_2 long-rectangular, subequal to vein M_3; *m-cu* close to fork of *M*.

Abdominal tergites brown, the disks of the intermediate ones vaguely patterned with yellow, sternites light yellow; segments eight and nine darker brown to form an inconspicuous ring; hypopygium brownish yellow. Male hypopygium with the interbase terminating in a narrow paddlelike blade, the tip obtuse.

HABITAT.—California (Monterey County).

HOLOTYPE, ♂, Salmon Creek, October 26, 1962 (Dennis Hynes); Hynes No. 69.

This distinct member of the genus is dedicated to the collector. The only other described western Nearctic species that lacks macrotrichia in the outer wing cells is *Lipsothrix fenderi* Alexander, readily told by the pale yellow coloration of the body and wings, coloration of the legs, short antennae, and the details of venation. The darkened wing pattern of the present fly likewise distingiushes it from all other American species of the genus.

Ormosia (*Ormosia*) *burneyana*, n.sp.

Allied to *pleuracantha;* general coloration of thorax brownish gray; antennae of male long, scape and pedicel yellow, flagellum black; segments strongly narrowed outwardly, provided with conspicuous erect yellow setae; male hypopygium with the mesal face of basistyle very unequally bispinous, both spines directed caudad; outer dististyle a flattened suboval plate, its outer angle scabrous, produced into two or three small thorns and a single long spine.

MALE.—Length about 4.5 - 4.7 mm.; wing 5.8 - 6 mm.; antenna about 2.1 - 2.2 mm.

FEMALE.—Length about 5.5 mm.; wing 6 mm.

Rostrum and palpi black. Antennae of male long, exceeding one-third the wing; scape and pedicel brownish yellow, flagellum black; flagellar segments enlarged basally, narrowed outwardly, surface with abundant erect yellow setae; verticils black, unilaterally arranged on outer face. Head light gray.

Pronotum light brown, lateral ends of scutellum yellow. Mesonotal praescutum gray with four more brownish gray stripes that are only vaguely indicated, the capillary median line still darker brown; posterior sclerites brownish gray, parascutella yellowish brown. Pleura brownish gray. Halteres with stem yellow, knob slightly darker. Legs with coxae obscure yellow, trochanters clear light yellow; femora brownish yellow, brighter at bases; tibiae and tarsi light brown. Wings weakly infuscated, stigma large, darker brown; a large cream-colored area before cord and stigma, with a smaller marking beyond the stigma; veins brown, more yellowed in the pale areas. Venation: Sc_1 ending just beyond R_2, Sc_2 about opposite two-fifths *Rs*; vein R_2 near fork of R_{2+3+4}; *m-cu* close to fork of *M*; vein *2nd A* sinuous.

Abdomen dark brown. Male hypopygium with the tergite large, lateral lobes scarcely developed, provided with very long decussate yellow setae. Basistyle on mesal face with a narrow plate that is very unequally bispinous, the long outer spine gently curved, the tiny more basal one straight, both spines directed caudad. Outer dististyle a flattened suboval plate, the outer angle produced into two or three small acute thorns, the surface roughened and short hairy; a much longer spine lying across the face of style; inner disti-

style horn-yellow, simple, narrowed to the obtuse tip, the outer half chiefly membranous. Phallosome with gonapophyses appearing as long horn-yellow blades, narrowed very gradually into pale membrane, longer than the aedeagus.

HABITAT.—California (Shasta County).

HOLOTYPE. ♂, Burney Falls, August 1, 1958, swept from vegetation at foot of falls (Alexander). ALLOTYPE, ♀, with type. PARATOPOTYPES, 3 ♂♂.

Ormosia (*Ormosia*) *burneyana* is allied to but quite distinct from *O.* (*O.*) *pleuracantha* Alexander, differing in the structure of the hypopygium, especially the basistyle and outer dististyle.

TWO NEW SPECIES OF LACEBUGS FROM INDIA (HEMIPTERA: TINGIDAE)

Carl J. Drake[1] and David Livingstone[2]

The present paper charatcerizes a new species of the lacebug genus *Tingis* Fabricius and another of *Monosteira* Costa from India. In the structural measurements, 80 units equal 1 millimeter. The holotypes are in the Drake Collection (USNM). The illustration was drawn by Miss Lisa Biganoli, Washington, D. C. This study and others in progress are supported in part by a grant from the National Science Foundation (GB-791).

Tingis agrana, sp. nov.

Obovate, grayish testaceous, with a small spot at each juncture of the transverse vein of costal area and outer marginal vein of elytron plus some veinlets in paranotum opposite humeral angle blackish; pronotal disc and head dark reddish brown; body beneath dark brown, the pronotal sterna and pleura blackish. Antennae blackish fuscous with third segment brown. Legs blackish fuscous with tips of femora, tibiae, and base of tarsi brown. Entire dorsal surface rather thickly clothed with fine, recumbent, yellowish or whitish pubescent hairs, the head and forepart of pronotum with some whitish exudate; body beneath sparcely clothed with short pale hairs. Antennae and legs with short, pale, setose hairs. Length 3.25 mm., width (across middle of elytra) 1.50 mm.

Head very short, little produced in front of eyes, sharply declivent in front, armed with five short pale spines; bucculae areolate, closed or nearly closed in front. Labium brownish, extending to base of mesosternum; laminae of rostral sulcus low, areolate, divergent posteriorly, open at base. Antennae rather short, moderately slender, measurements: segment I, 0.20 mm.; II, 0.15 mm.; III, 0.80 mm.; IV, 0.50 mm. Legs rather short, femora slightly swollen. Hypocostal lamina composed of one row of quadrate areolae.

Pronotum broad, coarsely pitted, moderately convex, areolate on triangular projection, tricarinate; all carinae long, raised, each composed of one row of fairly large areolae; lateral carinae not quite as high as median, slightly concave within in front of middle of disc; hood moderately large, almost quadrate in outline, extending backwards on forepart of pronotal disc, feebly produced in front, dorsal surface obtusely tectiform; paranotum wide, long, reflexed upward, triseriate opposite humeral angle, then biseriate anteriorly.

Elytra with sutural areas overlapping each other so as to rest in repose jointly rounded behind, scarcely wider at widest point than

1. Smithsonian Institution, Washington, D.C.
2. St. John's College, Agra, India.

width across humeral angles of pronotum; costal area biseriate, areolae irregular in form and arrangement; subcostal area biseriate, areolae arranged in regular rows; discoidal area very large, three-fourths as long as elytron, acutely angulate at each end, five or six areolae deep at widest point near middle. Wings almost as long as elytra, slightly clouded with fuscous.

HOLOTYPE (male) and ALLOTYPE (female), both macropterous, Agra, India, September, 1960.

The wider paranota, obovate form, and shorter appendages separate this species from other hairy members of the genus in the Orient.

Monosteira edeia, sp. nov.

Figure 1

Monosteira minutula (not Montandon): Livingstone, Agra Univ. Journ. Research (Sci.), vol. 11, pp. 117-129, figs. 1-10 (biology and morphology).

Small, testaceous to brownish testaceous with pronotal disc blackish fuscous in male and usually dark stramineous in female; front row of areolae on collar and flap of each paranotum opposite its respective callus testaceous; body beneath reddish brown with sternum black. Appendages testaceous with tips of tarsi and fourth antennal segments brownish. Length 1.80 mm., width (elytra) 0.60 mm.

Head very short, feebly extended in front of eyes, armed above with five short spines, the hind pair appressed and longer than the others; bucculae wide, areolate, closed in front. Labium extending to middle of mesosternum; laminae of rostral sulcus present on all three sternal divisions of pronotum, low on prosternum, open behind. Hypocostal laminae biseriate from base to beyond middle, thence posteriorly uniseriate. Antennae inconspicuously pubescent, segment IV subfusiform, measurements: segment I, 0.07 mm.; II, 0.06 mm.; III, 0.28 mm.; IV, 0.15 mm.

Pronotum moderately convex, punctate, unicarinate, backward projection of hind margin areolate; median carina percurrent, present even on collar, finely areolate, the areolae slightly larger on pronotal disc and backward projection of hind margin; collar narrow, areolate, truncate in front; paranota narrow, long, cariniform, each composed of a single row of tiny areolae from the base behind humeral angle to callus, then opposite callus suddenly expanded, flaplike and in there two or three areolae deep.

Elytra not much wider than transhumeral width, longer than abdomen; costal area narrow, composed of one row of areolae; subcostal area wider, sloping sharply downward, four areolae deep in widest part; discoidal area about five-sevenths as long as elytra, divided behind the middle by a crossvein, with hinder part shorter than forepart and concavely extended outward into subcostal area

(fig. 1); sutural area wide, overlapping other elytron in resting posture. Hind wings not much shorter than elytra, functional, whitish opaque. Legs rather short, femora slightly swollen.

HOLOTYPE (male) and ALLOTYPE (female), both macropterous, Agra, India, May 1962, on *Ziziphus jujuba*, in Drake Collection (USNM). PARATYPES, numerous specimens, taken in same locality and on same food plant as type, Agra, March to October 1962-1963.

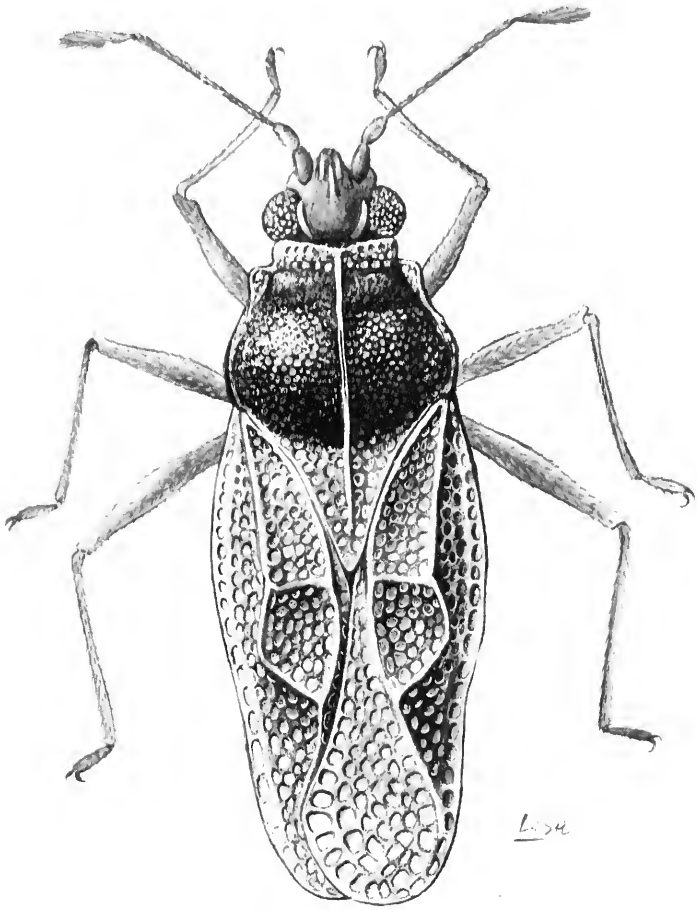


Figure 1. *Monosteira edeia*, sp. nov.

This species is the same size and very similar in general aspect to the Palaearctic *M. minutula* Montandon and *M. priesneri* Wagner, but can be separated at once from either of them by the

long, narrow, keel-like, unicarinate paranota, each of which is suddenly expanded and auriculate opposite the callus and there two or three areolae deep. This is the only member of the genus known to occur in Asia. A macropterous paratype is figured.

STUDIES IN NEARCTIC DESERT SAND DUNE ORTHOPTERA

Part IX. A new *Trimerotropis* from southern Idaho Dunes

Ernest R. Tinkham[1]

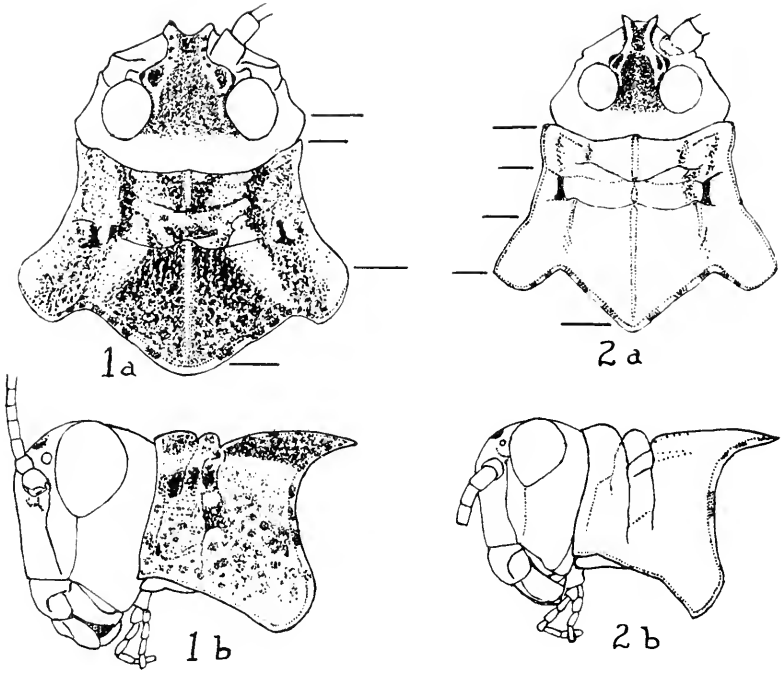
The sand dune areas of our North American deserts are so numerous that it is impossible for one to know all of them, especially in the early stages of investigation, and so when I conducted my sand dune biotae studies in the Great Basin Desert, in the late summer of 1957 and the summer of 1958 under grant from the National Science Foundation, I was unaware of those in southern Idaho. These were first brought to my attention by Dr. James Gillaspy, authority on the Bembecidae, and this knowledge led to contact with Dr. W. F. Barr, head of the Department of Entomology at the University of Idaho, just as he was leaving on his sabbatical. Later, in 1960, I noted an interesting new race of *Trimerotropis agrestis* from an Idaho dune reposing in the great Orthopterological Collection of the Museum of Zoology at the University of Michigan. Later, correspondence was resumed with Dr. Barr and through him and his graduate student, Mr. George B. Hewitt, I am indebted for the considerable collections of this new race made during 1962 and 1963. For his studies and efforts, it is a pleasure to name the new race in honor of this new student in the field of orthopterology.

Trimerotropis agrestis hewitti, new subspecies

Of the members of the *T. agrestis* group, this new subspecies is most closely related to *T. a. barnumi* Tinkham, 1960. It is intermediate in size between *barnumi* and *T. a. gracewileyae* Tinkham, 1960, from the San Rafael Desert of southeastern Utah. From *T. a. barnumi* it is distinguished by the following features: slightly larger size, the more strongly reflexed and proportionately larger, quadrate, posterior lateral lobe of the pronotum, as seen from above, and which immediately separates it from all other species of the genus, by the more acutely angular anterior lateral lobe of the pronotum, by the more roundly angular posterior angle of the dorsum of the metazona which in *barnumi* is squarely angular, by the relatively broader head especially in the clypeal suture section which thus produces a shallower depth to the head, by the more evenly rounded outline of the inferior margin of the lateral lobes of the pronotum when observed from above and which in *barnumi* is more angular, and by, perhaps, other minor features as well.

Description of Male Holotype: Head at the clypeal level slightly broader than is normal for the genus, its breadth equal to the clypeus so that the head is broader and shallower in depth than in other species of the genus *Trimerotropis*. Compound eye subglobular, its ventral depth equal to the length of the genal groove;

1. Indio, California.



Explanation of Plate

1 a. *Trimerotropis agrestis hewitti* n. subsp. Dorsal view of head and pronotum of Holotype Male, Sand Dune Lake dunes, Owyhee Co., Idaho.
1. b. Lateral view of Holotype Male of *T. a. hewitti* n. subsp.
2 a. *Trimerotropic a. barnumi* Tinkham. Dorsal view of Holotype Male. Oak City Dunes, Millard Co., Utah.
2 b. Lateral view of Holotype Male of *T. a. barnumi.*

All drawings executed on same scale and drawn 6.0 x natural size. Drawings reduced by reproduction about one-sixth. Line arrows indicate salient comparative features.

its fore margin evenly arcuate, posterior margin circularly rounded. Fastigium, seen in profile, gently sloping to the lateral foveolae, thence more declivent to round into the frontal costa at the upper level of the antennal scrobes; lateral carinae of the fastigium percurrent with those of the frontal costa. From above, lateral carinae of the fastigium diverging gently to the front margin of the compound eyes and the posterior angle of the triangulate lateral fovelae of the vertex, thence converging to the frontal costa where it diverges gently to the central portion of the face below the median ocellus. From this area the roundly angular carinae of the frontal costa becomes rounded as it diverges strongly to the lower margin of the face. Fastigium moderately impressed between the compound eyes, shallower between the lateral foveolae, frontal costa concavely impressed for its length to where the keels diverge strongyl in the lower half of the face. Plane of the median ocellus directed downwards so

that the frontal costa is most deeply impressed or excavate just below that organ. Lateral facial carinae prominant, curving around the base of the antennae, thence diverging strongly to meet the outer margins of the narrow but very broad clypeus. Lateral ocellus just above the middle of the fore margin of the compound eye. Antennae reaching to the extreme base of the caudal femora.

Pronotum rather short and broad dorsally with deep lateral lobes, the posterior angle of which is not only broadly and angularly lobular in outline but more strongly reflexed than in any other North American species of *Trimerotropis*, so much so that its outline is conspicuous when viewed from above. Median carina strongly defined in the frontal half, less defined in the posterior half of the pronotum, the principal sulcus cutting about the anterior third, the prozonal crest further dissected about the posterior third thus forming the typical bilobate prozonal crest of the genus. Lateral margins of the posterior lobes of the pronotum diverging ventrally, the narrowest portion just below the slight metazonal shoulder, which is well rounded except on the anterior quarter, where it is slightly angular. Fore margin not squarely truncate but very slightly produced; posterior margin very broadly rounded on the posterior angle. Sternum typical. Tegmina exceeding apex of abdomen by one third the total length of the body.

Coloration: General coloration arenaceous above, thoracic sternites chrome yellow, abdominal segments entirely chrome yellow. Dorsum of pronotum heavily punctate with black, the prozonal and metazonal shoulder areas marked with a narrow yellowish stripe. Lateral lobes of the pronotum generally blackish white with two small central whitish areas and the reflexed posterior angle of the lateral lobes and lower marginal area whitish. Head generally whitish with blackish infiltrations surrounding scattered punctae on the face, posterior portions of the genae more infuscated with darker gray.

Tegmina plain isabelline without indications of any cross bands, the veins and cross veins mostly white, cells mostly semitranslucent with scattered infuscated irregular cells, those in the apical third the largest. Angulate anal area yellow white, the cells of the posterior anal area generally infuscate. Wing with disc pale yellow and 10 mm. broad; black band at maximum breadth just anteriorad of posterior margin, 8 mm., and slightly less than one third the total length of the wing, the anterior portion bearing an indistinctly blunt apex, this area distinctly separated from the rest of the band by the pale yellowish cubital area. Posterior inner angle of band blunt and not quite reaching the posterior angle of the wing. Apical portion of the wing beyond the band, hyaline, with black veins.

Caudal femora with inner face plain orange red, outer pagina with upper sulcus tan with subbasal, median and subapical infuscated areas which are indicated but less defined on the outer face; lower sulcus whitish, genicular areas slightly infuscated. Caudal tibiae orange red with basal quarter paler, spines black tipped.

Holotype Male: Sand Dune Lake, 8 miles NE of Bruneau, Owyhee County, Idaho, Sept. 4, 1962, George B. Hewitt. Calliper measurements in mms.: body length 26.8; length to apex of tegmen 34.1; pronotum 5.2 x 4.6; lateral lobe of pronotum 4.9 from metazonal shoulder to apex of posterior lateral lobe x 3.5 in width just ventrad of shoulder; caudal femora 15.5 x 4.1 near base; tegmen 28.6 x 4.2 mm. Through the courtesy of Dr. W. F. Barr, head of the Department of Entomology of the University of Idaho, the male holotype will be deposited at the California Academy of Sciences on an indefinite loan basis.

Description: Female considerably larger than the male but otherwise very closely similar. Fastigium of the vertex very slightly less impressed than in the male. Keels of the frontal costa slightly more parallel than in the male. Head, from in front, with genae just below the compound eyes appearing slightly more convex and fuller than in the male. Relative breadth of the vertex the same in both sexes. Bilobate crest of prozona slightly less prominent than in the male. Jaws of the ovipositor typical of the genus. In all other respects the female is typical of the male.

Allotype Female: Indian Cove (immediately east over ridge from Sand Dune Lake), Owyhee County, Idaho, July 30, 1932, A. C. Cole collector (Museum of Zoology, Michigan). Measurements in millimeters: Body length 34.2, length to apex of tegmen 43.1; pronotum 6.9 x 6.3; lateral lobe of pronotum 6.1 x 4.4; tegmen 44.4 x 6.4; wing 31.5 x 18.2 mm. Allotype female deposited in the Orthoptera Collection of the Museum of Zoology, University of Michigan.

Paratype Males: Sand Dune Lake dunes, 12, Sept. 4, 1963; 15, July 18, 1963, O. O. Fillmore and G. B. Hewitt; 13, Sept. 9, 1963, W. F. Barr and George B. Hewitt. Dietrich Butte, Lincoln Co., Idaho, 2, July 29, 1, July 31, 1, Aug. 3, 1955, James E. Gallaspy; 3, July 20, 1962, George B. Hewitt. Range in millimeters: body length 24.8 - 28.9; body length to apices of tegmina 32.5 - 36.0; pronotum 4.8 - 5.6 x 4.5 - 4.8; lateral lobes of pronotum 4.2 - 5.5 (max. depth) x 3.9 - 4.6 (max. breadth); tegmina 27.0 - 30.5; caudal femora 13.6 - 16.0 mm. Thanks to the courtesy of Dr. W. F. Barr, paratype males will be deposited in the major orthopterological museums such as USNM, ANSP, MZM. Tinkham Eremological Cln, also Minnesota, Brigham Young, Los Angeles County Museum and California Academy of Sciences.

Paratype males similar to the holotype in every respect; some males tinged with rust red along anal vein, pronotum and upper sulcus of caudal femora.

Paratype Females: Sand Dune Lake dunes, 5, July 18, G. B. Hewitt; 12, July 18, 1963, O. O. Fillmore and G. B. Hewitt. Dietrich Butte, Lincoln Co., Idaho, 1, Aug. 3, 1955, J. E. Gillaspy; 2, July 20, 1962, George B. Hewitt.

Range in millimeters: Body length 29.6 - 33.8; length to apex of tegmen 35.3 - 43.9; pronotum 5.3 - 6.8 x 4.9 - 6.1; lateral lobes 4.9 - 5.7 x 4.3 - 5.1; tegmina 29.1 - 35.4; caudal femora 15.0 - 18.9 mm. Deposition as indicated for Paratype males. Paratype females identical of Allotype.

DESCRIPTION OF SAND DUNES: In a very recent communication Dr. W. F. Barr has furnished the following information: "The Bruneau sand dunes are located approximately 8 miles northeast of Bruneau and the locality is frequently known now as Sand Dune Lake. The dunes themselves are extremely large and active and surround several small fresh water lakes than have come into existence as a result of underground backup from the Strike Dam on the Snake River. The dunes lie in the southern portion of a small basin that extends several miles northward and opens on the Snake River. Several square miles of area are occupied by the dunes. Vegetation on the peripheral sandy areas includes *Artemesia tridentata*, *Chrysothamnus nauseosus* and *viscidiflorus*, *Atriplex canescens*, *Psoralea lanceolata*, Indian rice grass, balsam root and other annuals. Willows, cottonwood and Russian olive trees have been planted near the shores of the small lakes.

"Indian Cove is an agricultural area over the ridge immediately to the east of the sand dune area. This is a larger basin than the sand dune basin which is sometimes also referred to as Eagle Cove.

"The Dietrich Butte sandy area is located as a relatively flat blow area with drifting sand over several hundred acres on the northeast slope of the eastern butte. The areas surrounding the sand formerly were in sagebrush but have been badly burned over many times for many years. Consequently, the vegetation around the sand is annual and consists predominantly of cheat grass and mustards."

ORTHOPTERAN ASSOCIATES: According to a note from Mr. George B. Hewitt, these are: *Trimerotropis arenacea*, *T. bilobata*, *T. gracilis*, *T. pallidipennis*, *Conozoa wallula* and others.

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A BRIEF HISTORICAL RÉSUMÉ OF HERPETOLOGICAL STUDIES IN THE GREAT BASIN OF THE WESTERN UNITED STATES

PART I. THE REPTILES[1]

Benjamin H. Banta and Wilmer W. Tanner

INTRODUCTION

Among the numerous accounts of the early travelers into the western United States are those reports which introduce to us the Great Basin and its natural history. In this presentation we will only briefly review the faunistic and systematic studies which are of historical importance to the herpetology of the Great Basin. Although many workers have referred in one way or another to this vast inland basin region, we will include only those accounts which have, in our opinion, made a contribution to a better understanding of our knowledge of the biology of its herpetofauna. We have, therefore, been arbitrary in selecting only those studies which have dealt with Great Basin material. This has eliminated many excellent studies dealing with areas adjoining the basin itself.

The Great Basin, consisting of a number of distinct and disjunct inland basins with its lakes and desert basins surrounded by usually north-south oriented mountains, is a most remarkable geographical region. Most Americans have heard of, and perhaps remember, some of the tales of pioneers who traversed the area a hundred years ago. However, few are aware of the contributions made by those naturalists who for over a hundred years have been slowly extracting bit by bit a more comprehensive knowledge of the natural history from this still relatively inhospitable region.

Both authors have not only lived for many years in the Great Basin, but have also done considerable herpetological field work in various portions of it. The senior author has lived a number of years in the western part (Lahontan Basin) and is familiar with the east-

1. Part of this report was supported by a grant-in-aid from the Johnson Fund of the American Philosophical Society awarded to the senior author (Colorado College, Colorado Springs), other parts by the Brigham Young University sabbatical research program (Department of Zoology, B.Y.U., Provo, Utah), and publication was supported by a grant-in-aid from the Society of the Sigma Xi and the Research Society of America. For aid and courtesies shown, we wish to especially thank Vasco M. Tanner and D Elden Beck.

ern California and western Nevada basins, whereas the junior author is acquainted with the eastern part (Bonneville Basin) and is familiar with the eastern Nevada and the western Utah basins. One or both of us have extended our field work into other basins, among which are Truckee Meadows, Lake Tahoe, Amargosa Desert, Sarcobatus Flat, Charleston Mountains, Inyo Mountains, Saline Valley, Railroad Valley, Death Valley and the valleys of the Nevada Test Site. Thus we are familiar with many of the valleys and mountains and particularly with the major ones included in figure 1.

The Great Basin is not only a fascinating area geographically, but is comparably challenging from the standpoint of its fauna. Although much of the region is desert or semi-desert, it contains many herpetological species, most of which are to this day poorly known. Although most of the segments of the herpetofauna inhabit the desert valleys and the low, usually barren mountain ranges, a few species have survived in the more mesic situations of the mountains on the east and west perimeters and the forested mountains of the interior. These montane forms probably enjoyed a much wider distribution during the moist pluvial periods of the Pleistocene.

The physical delimitation of the Great Basin in this account is based on the 1953 edition of the map "Water Resources Development of the United States" by the United States Geological Survey. The Great Basin thus comprises all the land area not presently being drained into the Pacific Ocean, and which occurs between the crest of the Wasatch uplift in central Utah and southwestern Wyoming and the summits of the Sierra Nevada in eastern California (see figure 1).

HISTORICAL

The observation, collection, and the first organized study of the reptiles inhabiting the Great Basin began during the westward expansion and settlement over a century ago. Some of the historical aspects of zoological reconnaissance in the Great Basin are discussed in the works of Cope (1893), Merriam (1895), Van Denburgh and Slevin (1915), V. M. Tanner (1929 and 1940), Linsdale (1936, 1938, and 1940), Hall (1946), Durrant (1952) and Tanner and Jorgensen (1963).

The region was visited by white men as early as 1776 when Escalante and his party of Franciscan missionaries from New Mexico crossed the southern and eastern portions en route to California (Tanner, 1929, 1940; Woodbury, 1931). The northern and central portions of the territory were crossed by Jedediah Smith in 1826 and by Bonneville and Walker in 1833-1834. Captain John Charles Fremont was the first to apply the name "Great Basin" to this vast interior drainage region of Western North America. Although some of these earlier exploratory expeditions did record observations of reptiles in their journals, and published reports, few specimens, if any, were collected and adequately preserved prior to 1850, or at least such specimens are to our knowledge not currently available for examination.

Many of the members of the early surveys were too busy mapping new routes, sketching and drawing new topographic features for the first time, and struggling with means of transportation to be vitally concerned with faunistic samples. Combine these factors with their fear for hostile Indians and renegades, and the accomplishments of these early surveyors were indeed impressive.

Following the conquest of the large western area of the North American continent from Mexico in 1848, which made the area including most of the Great Basin an integral part of the United States of America, there were, according to Nolan (1943) "numerous explorations by United States Army Engineers to determine the available railroad routes to the Pacific Coast. The most thorough

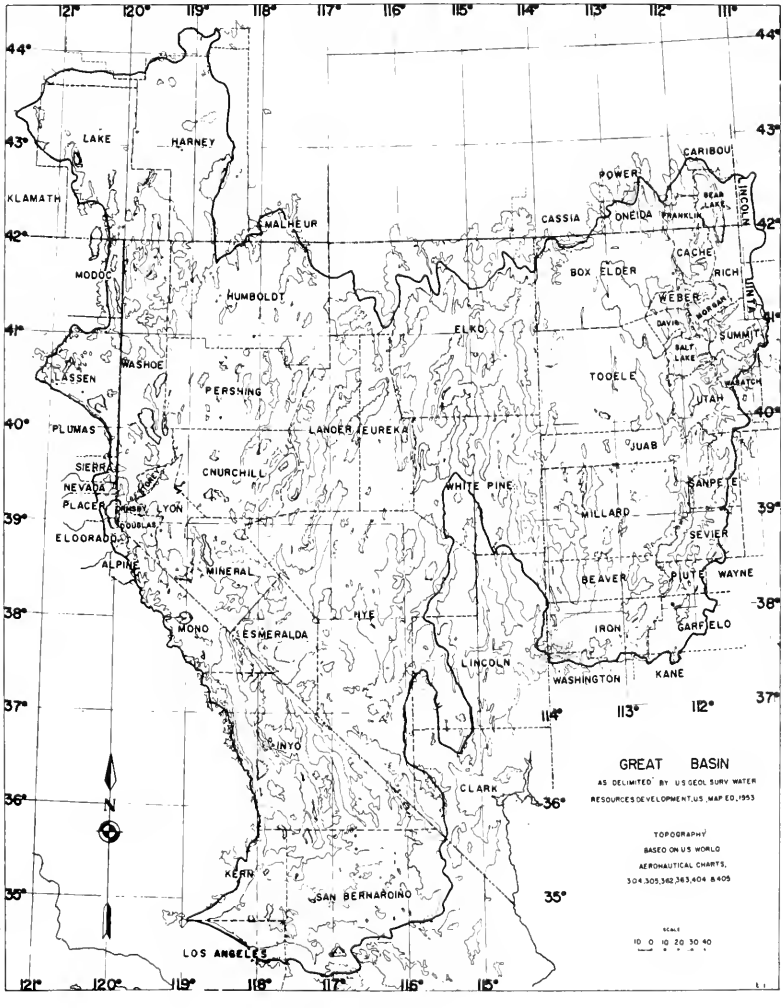

Fig. 1. Great Basin.

of the explorations were made across the north part of the Basin by Stansbury (1849), Beckwith (1854), Steptoe (1855), and Simpson (1858-9), and made across the southern portion by Whipple (1853) and Williamson (1854)." These surveys, known collectively as the Pacific Railroad Surveys, were sponsored by the Office of Explorations and Surveys, United States War Department, and most of the various tasks were performed by military personnel.

Spencer Fullerton Baird, at that time Assistant Secretary of the Smithsonian Institution of Washington, D. C., was responsible for the preparation of a series of preliminary and more detailed illustrated accounts of the reptiles collected on these surveys. Baird and Charles Girard (1852) published several accounts, with original descriptions of new species collected in the Great Basin, which were deposited in the National Museum.

James Graham Cooper (1870) reviewed for the first time some of the aspects of the geographical distribution of the fauna of California, and although he dealt mainly with the mammals and birds, reptiles were occasionally mentioned. Cooper noted, perhaps for the first time, the distinct character of the desert fauna of the Western Great Basin.

After the Civil War the United States government continued to sponsor expeditions to western North America to obtain more definitive information on the region. Surveys of the geology of the United States along the 40th parallel were organized under the leadership of Clarence King. Actual field operations were begun in 1867, and continued to 1873. Although primarily concerned with geological reconnaissance, a young zoologist, Robert Ridgway, was assigned to the expedition to collect mammals, birds and reptiles in the western Great Basin from July 4, 1867, until late September 1868. Ridgway's route of travel, according to a report by Harry Harris (1928), extended from California across Nevada to Utah and included among others such well known collecting sights as Truckee Meadows, Reno, Pyramid Lake, Ruby Mountains, Parley's Park (Wasatch Mts.) and Pack's Canyon (Uintah Mts.). In May, 1869, he returned to the Wasatch and Uintah Mountains to complete the survey in these areas. Specimens collected by Ridgway were deposited in the United States National Museum and are included in the report by Yarrow (1882).

In the tradition of the War Department, who sponsored the Railroad Surveys prior to the Civil War, the geographical surveys west of the 100th Meridian were organized by the War Department under the command of Lieutenant George Montague Wheeler in 1869. Teams of this survey (commonly referred to as the "Wheeler Survey") were active in part of the Great Basin from 1869 to 1878. Henry Wetherbee Henshaw worked as a zoologist on the Wheeler survey beginning in July, 1872, at Salt Lake City where he met Lt. Wheeler and became associated with the survey for the next eight years. On July 22, Henshaw and H. C. Yarrow left for Provo and the environs of Utah Lake. Thus was launched one of the more successful natural history surveys of the west. The western Great Basin was not visited for several years; however, their itinerary brought the

survey in the area of Carson City, Nevada, from August until September 15, 1876. From September 15 until November 7, Henshaw collected in the vicinity of Lake Tahoe (California-Nevada). Linsdale (1936:9) asserted that "In 1877 his field work began at Carson City, Nevada, where he worked from May 12 to June 6, and then started northward to end the season on October 1, in southern Oregon." During July 1878, Henshaw again started from Carson City and worked northward, collecting specimens of birds, reptiles, and amphibians, which were deposited in the United States National Museum. Dr. Harry Crècy Yarrow accompanied Henshaw during one field season in eastern Nevada. The herpetological results of all their field work were published by Yarrow and Henshaw (1878).

According to Henry Fairfield Osborn (1931), Edward Drinker Cope traversed the Great Basin, traveling from Salt Lake City, Utah, to Reno, Nevada, during 1879. In 1882 Cope returned to the Great Basin, traveling to Reno, then to Silver Lake, Oregon, back again to Reno, then to southern Idaho, and back again to Salt Lake City. Various aspects of the zoogeographic data obtained were subquently published by Cope (1883a, b, c; 1889, 1896a, b; 1900).

Before actually visiting the Great Basin Cope published (1875) in the first Bulletin of the United States National Museum his Checklist of North American Batrachia and Reptilia including a listing of the higher groups and an essay on geographical distribution. Yarrow (1883) published a check list of North American reptiles and amphibians deposited in the United States National Museum, providing a list and a classification of all specimens of amphibians and reptiles collected by military and government personnel during the various surveys before 1882. This report included not only Great Basin records but records from other portions of the United States as well.

Little was added to the zoological literature from the western United States until the appearance of Clinton Hart Merriam's treatise on the biota of the San Francisco Mountains of Arizona (1890). Shortly after this, the Death Valley Expedition was organized under the direction of Merriam. This was the last of the major government-sponsored exploratory expeditions in the western United States in the 19th century. Informative accounts of this survey, which entered many parts of the southwestern Great Basin, are furnished by Cope (1893), Merriam (1895), and by Stejneger (1893).

Since the Death Valley Expedition, the United States National Museum has received specimens of reptiles collected in various parts of the Great Basin from several field representatives of government agencies, such as the Bureau of Biological Survey, and its successor, the Fish and Wildlife Service. Agencies created during the years of the depression (e.g., the Civilian Conservation Corps and Works Progress Administration), were responsible for the addition of specimens to the National Museum as well as to other institutions maintaining scientific collections. Several interested persons have sporadically contributed small samplings of the Great Basin herpetofauna to

the National Museum collections (e.g., Charles E. Burt, Paul Bartsch, Julius Hurter, J. O. Snyder and Adrian Vanderhorst).

John Van Denburgh (1897) presented the first account of the reptiles of the Pacific Coast and Great Basin, as his doctoral dissertation at Stanford University. Robert Baird McLain (1899), in a privately published pamphlet, was sharply critical of Van Denburgh's work. Several groups were critically reviewed (e.g., *Sceloporus occidentalis*), but generally speaking, McLain merely provided specimen documentation for the information included by Van Denburgh. Both Van Denburgh's and McLain's papers were based upon preserved specimens in the collection at Stanford University.

From May 23 to July 17, 1911, Professor John Otterbein Snyder, Stanford University, and Charles Howard Richardson, Jr., who in 1909 had assisted Walter Penn Taylor in Humbodlt County, Nevada, collected a large sample of reptiles in the Lahontan Basin of west central Nevada and east central California. This work was done in conjunction with the ichthyological investigations of Snyder (1917) partly under the auspices of the United States Bureau of Fisheries. The herpetological results of this work were published by Richardson (1915). In this study, it was first pointed out that certain meristic and morphometric variations existed between the lizard populations of the Lahontan Basin and those of the more extensive and warmer deserts to the south. Richardson was also the first author to discern the difference between the sagebrush steppe and the cold desert areas. He noted that, "The flora of the desert immediately south of Pyramid and Walker Lakes is of a different character [than the sagebrush, *Artemisia tridentata*, predominating over the greater part of Nevada] Sarcobatus and other shrubs replacing, 'sagebrush.' This difference in the flora is correlated with a greater diversity in the reptilian fauna, and we find such southern forms as *Callisaurus* and *Sceloporus magister*." Most of the specimens obtained by Richardson and Snyder are now deposited in the Division of Systematic Biology (formerly the Natural History Museum), Stanford University, and in the United States National Museum. Around the area of Currant, in northeastern Nye County, Nevada, Georgia M. Bentley collected reptiles for the Natural History Museum, Stanford University, during the spring of 1916. Some of Bentley's observations were published (1918, 1919). The growth of the herpetological collection at Stanford University has continued, owing largely to the encouragement of field activities by Professor George Sprague Myers and the late Margaret Hamilton Storey. A brief historical review of the Stanford collections has been published by Leviton (1953). Banta (1957) has reported on some aspects of material obtained by him in the Great Basin and deposited in the Stanford collections.

Witmer Stone (1911) published a list of the amphibians and reptiles collected in the western Great Basin, and portions of several western states as well, which were deposited in the collections of the Academy of Natural Sciences of Philadelphia. This study was based

on material obtained by Mr. Morgan Hebard and Mr. James A. G. Rehn during the summers of 1909 and 1910.

During the summer of 1912, the University of Michigan Museum of Zoology sponsored a zoological expedition composed of Frederic M. Gaige, Helen Thompson and Alexander Grant Ruthven, to northeastern Nevada. In addition to the herpetofauna, samples of molluscs, crustaceans and ants were obtained and studied. The exact area sampled was near the environs of the railroad town of Carlin in the western part of Elko County, and the northern part of Eureka County. Most of the specimens collected by the Michigan expedition were deposited in the Museum of Zoology at the University of Michigan. Ruthven and Helen Thompson Gaige (1915) published the herpetological results of these field studies. This expedition, and the numerous published results which were to follow, inaugurated several studies on the herpetofauna of the Great Basin by members of the University of Michigan group. Ruthven (1926, 1932) and Lawrence Cooper Stuart (1932) continued to work in the eastern Great Basin for the Museum of Zoology. In 1936, Frank N. Blanchard visited the collections at Brigham Young University, University of Utah, California Academy of Sciences and other western collections. He completed the data needed for the study of the genus *Tantilla* (1939:post humously) which included several new descriptions.

During the 1930's Carl Leavitt Hubbs and his family obtained a large series of amphibians (mostly) and reptiles from widely scattered localities in the Great Basin. In the early forties Hubbs was assisted by Robert Rush Miller, and together they gathered extensive samples of zoological material from the Great Basin. Most of the material obtained during their field trips was found near streams and springs and was obtained in conjunction with their intensive ichthyological sampling, and was deposited in the collections of the Museum of Zoology at Michigan University. Out of these activities Hubbs and Miller (1948) were to develop the first comprehensive synthesis of zoological and geological knowledge to solve some of the zoogeographic problems of the Great Basin. However, the very nature of this historic work was restricted because these authors dealt exclusively with the fresh water fishes, a very specialized and geographically restricted faunal group. Banta (1963a, b, c) has made a preliminary attempt to synthesize geological and zoological knowledge pertaining to the zoogeography of a terrestrial group, the lizards.

Joseph Grinnell and Hilda Wood Grinnell (1907) made a study of reptiles of Los Angeles County, California, which was the first study of the herpetofauna of a given political subdivision, part of which was within the confines of the Great Basin. They recognized the distinctions between faunas of the north and south slopes of the San Gabriel Mountains (i.e., the Great Basin and Pacific drainage faunas).

Walter Penn Taylor (1912) presented the first faunistic survey of a section of Nevada (northern Humbodlt County, vicinity of the

Pine Forest Mountains) which included a study of reptiles and amphibians, as well as the avifauna, inhabiting the area at that time. This treatise was done during the summer of 1909, under the direction of Joseph Grinnell. Taylor was assisted in the field by Mr. C. H. Richardson, Jr. This was the first of the prolonged and extensive zoological collecting and studies in the western Great Basin by students and staff of the University of California Museum of Vertebrate Zoology at Berkeley.

Charles Lewis Camp (1916) critically commented on the status of several western North American lizards, including species inhabiting the Great Basin, based upon samples in the herpetological collections of the Museum of Vertebrate Zoology at Berkeley, and was the first to suggest the extent of variation of several species. A more complete systematic and geographic account of California reptile samples at Berkeley was authored by Grinnell and Camp (1917), in which trinomial names were assigned to most of the species considered in conformity to the growing nominal recognition of geographic variation.

The Museum of Vertebrate Zoology sponsored numerous extensive collecting expeditions to Nevada during the thirties and early forties under the financial assistance of Miss Annie Montague Alexander. An early result of these efforts was compiled by Jean Myron Linsdale (1938) which included all terrestrial vertebrates of Big Smoky Valley region, in northwestern Nye County, with emphasis on birds and mammals. Linsdale later (1940) provided the most inclusive account of the amphibians and reptiles in the state of Nevada, based primarily upon material obtained by the extensive activities of staff and graduate students of the Museum of Vertebrate Zoology. Since Linsdale's paper was completed (early 1938) collectors for the Museum of Vertebrate Zoology have added several thousand more specimens of reptiles from the Great Basin to their collections, and much of this newer material has not yet been reported. Regarding the Museum of Vertebrate Zoology field activities, Linsdale (1940:197) stated, "On each expedition the collectors have been on the lookout for specimens of amphibians and reptiles in addition to *their main objectives which usually were concerned with mammals or birds.*" (our italics). Robert C. Stebbins' studies (1954, 1958) on western North American herpetology has included much information of import to the Great Basin. Ira John La Rivers (1942) made some additions to Linsdale's work on Nevada, based upon material which was to form the nucleus for the herpetological collection of the Museum of Biology at the University of Nevada, established largely through the interest of La Rivers. Banta (1950, 1953) has reported on some aspects of the growing University of Nevada collections.

In 1922 there appeared the two volume study of *The Reptiles of Western North America* by Dr. John Van Denburgh of the California Academy of Sciences. Considerable efforts had been expended in the compilation of this major report. During its many years of preparation, Van Denburgh dispatched Joseph Richard Slevin at

various times to many areas of the western United States, including some Great Basin localities, to obtain specimen material. The various lists published by Van Denburgh and Slevin prior to 1922 (1912a, b, 1915, 1921a, 1921b) were simply progress reports of this major effort. Van Denburgh included material on the habits and life histories as well as systematic notes and distribution records, the latter based chiefly on material in the California Academy of Sciences and Stanford University collections. The black and white photographs illustrating many of the species treated in this work remain some of the best yet available. An account reviewing the herpetological activities of the California Academy of Sciences is provided by Slevin and Leviton (1956). Material obtained in the Saline Valley hydrographic basin by Banta (1963b) is deposited in the collections of the California Academy of Sciences.

During the summer of 1928 Charles Earle Burt and May Danheim Burt collected herpetological specimens in the Great Basin incidental to traveling through the region en route to the Pacific Coast. The material collected was deposited in the Museum of Zoology, University of Michigan and the United States National Museum (Burt and Burt, 1929). The Burts repeated their journey across the Great Basin during August of 1932 and further elaborated on their experiences similar to those of 1928 (Burt, 1933). Most of the specimens obtained in 1932 were deposited in the United States National Museum.

As noted above most of the references have referred to the western Great Basin in Nevada and California. However, the eastern part in Utah and eastern Nevada was being worked by various herpetologists, particularly since 1918.

An active period of herpetological research began in 1922 and 1925 when Herbert J. Pack at Utah State College and Vasco M. Tanner at Brigham Young University initiated their studies at Logan and Provo, Utah. V. M. Tanner was one of the more active of the recent workers to carry out extensive studies on the fishes, amphibians and reptiles of the Great Basin.

The first important collections from this area (Bonneville Basin) were made by the Stansbury Expedition in 1849-50 and reported by Baird and Girard in 1852a and 1852b and by Girard in 1858. In these early reports are the original descriptions of eight Great Basin reptiles. Some have been reduced to subspecific status, but all still appear in the current check lists (Schmidt, 1953).

After these early reports few collections were made and reported until Herbert J. Pack began his herpetological activities at Utah State Agricultural College at Logan, Utah. His first reports appeared in 1918 and extended to 1930. Although Pack was interested in systematics, most of his reports were studies of food habits. His major systematic report was the "Snakes of Utah," published posthumously and edited by George Franklin Knowlton in 1930. Knowlton and his co-workers continued the studies of Pack (1935-1950), publishing a long series of papers mostly on lizard food habits. Some of the animals collected by Pack and Knowlton are deposited

in the collections at Brigham Young University and the California Academy of Sciences.

Members of the staff and various graduate students of Brigham Young University since 1925 have amassed a large collection of herpetological specimens from the eastern Great Basin. Vasco Myron Tanner initiated the assemblage of the collections and published a series of accounts dealing with the herpetofauna of the eastern Great Basin and the rest of the state of Utah (1927a, 1927b, 1928, 1929, 1930, 1933). Field groups under his direction were so organized as to provide for sampling of all of the vertebrate and arthropod animal groups. Through the combined efforts of both staff and students the herpetological collection at Brigham Young University has become one of the larger assemblages of Great Basin reptiles. After 1940 this collection began to receive exotic materials and has since become much more than an assemblage of local specimens. The influence of V. M. Tanner in the eastern Great Basin has been comparable to that of Van Denburgh, Grinnell and Klauber in the western and southern sections of the region. It has been these men, their students and co-workers, who have during this century extended the knowledge of Great Basin herpetology. Since 1950 Wilmer W. Tanner has assumed the general supervision of and has conducted research on the North American segments of the herpetological collections at Brigham Young University. His first paper appeared in 1939 followed by numerous other studies concerned with aspects of the Great Basin herpetofauna. The large series of herpetological samples obtained at the Atomic Energy Commission Nuclear Testing Site in southern Nye County, Nevada, was published by Tanner and Jorgensen (1963).

The first and, to date, only account dealing with the reptiles of Utah and the eastern Great Basin was compiled by Angus Munn Woodbury (1931). This account was based primarily on material at Brigham Young University and collections at the University of Utah, acquired primarily by various faculty members and to a limited extent from high school teachers in central Utah. Woodbury and a number of his students have continued studies on the herpetology of the eastern Great Basin, most notable being the studies on snake dens (1940-1951). The final reporting of the den studies was done at a symposium in June, 1950. The published reports appeared in 1951 and were authored by Woodbury, Vetas, Julian, Glissmeyer, Heyrend and Call, Smart and Sanders. John M. Legler is continuing herpetological studies at the University of Utah, Salt Lake City.

Richard Patton Erwin, a professional musician with an intense avocational interest in herpetology, provided some worthy collections and reports (1925- 1928) from Great Basin portions of Idaho. Much of Erwin's material is deposited at Brigham Young University and the California Academy of Sciences. His field notes and journals are also at Brigham Young University.

The herpetofauna of the Great Basin portion of the state of Oregon requires much more study. Kenneth Gordon (1939), Robert

Macleod Storm and Richard A. Pimental (1949) provided the most recent information on this area.

In the spring of 1931 and 1932, the southern portions of the Great Basin were visited and collected by Laurence Monroe Klauber. These activities were made in his spare time in association with business activities for hydroelectric power from Hoover Dam for use in San Diego, California. Klauber was one of the first discoverers and advocates of collecting reptiles on paved highways, traveling by automobile at slow speeds. This method has yielded specimens of reptiles once thought to be rare, now known to be quite common, especially nocturnal snakes. Klauber's comprehensive investigations of reptiles, especially rattlesnakes, since the late twenties (1929-1956) have usually included species inhabiting the Great Basin. His numerous studies on reptile systematics has been enhanced by the introduction and use of statistics in evaluating data.

Charles Mitchill Bogert (1930) compiled the second list of the Los Angeles County herpetofauna based on his extensive field work within the county borders during months of July and August. In 1935 he sampled amphibians and reptiles in the vicinity of Hoover (Boulder) Dam and the then newly-formed reservoir, Lake Mead. A report on these activities was coauthored by Raymond Bridgeman Cowles (1936). The specimens obtained were deposited in the collections of the University of California at Los Angeles to form the nucleus for a now quite extensive collection. Although most of Bogert's collecting activities were within the Colorado River Basin, a small sampling of the isolated Spring (Charleston) Mountains, located on the border of the southwestern Great Basin area and the Colorado River Basin, was obtained. Kenneth Stafford Norris (1953, 1958) in his work on the ecology of desert dwelling lizards is continuing studies in the Mojave Desert as well as other areas at the University of California at Los Angeles.

Recently a report by Frederick B. Turner and Roland H. Wauer (1963) listed the reptiles occurring in Death Valley and provided ecological notes for the species.

Jay Mathers Savage (1960) in a herpetozoogeographical review of Baja California, Mexico, extended portions of this effort to include all of continental North America. Savage eliminated the existence of the Great Basin as a faunal area and included it with adjacent areas under the ambiguous term "Desert and Plains." Under this category were also included most of central Baja California, Arizona (exclusive of the central portion), and the state of Sonora, Mexico. It is interesting to note that to construct his hypothesis on the origin of the herpetofauna of Baja California, Savage relied on the paleobotanical works of Axelrod (1940-1958) in the Great Basin, studies which so far have excluded Baja California. Yet Savage did not consider the Great Basin worthy of recognition in his overall classification of herpetofaunal areas.

We believe that the large number of species and subspecies largely restricted to the Great Basin justifies its recognition as a faunal area. A careful examination of both vertebrates and arthro-

pods indicates that this general area has been isolated for a long enough period of time to provide for the development of a distinct fauna. In all respects it is faunisticly distinct as are other adjacent areas. In the vertebrate groups adequate evidence is seemingly available in the many works dealing with the vertebrates of this area, but particularly in those of E. R. Hall, and S. D. Durant (mammals), E. D. Cope, L. M. Klauber, R. C. Stebbins, J. M. Linsdale, and the authors (reptiles) and J. O. Snyder, C. L. Hubbs, R. R. Miller, and V. M. Tanner (fishes).

To us the Great Basin represents not only a distinct physiographic region but also an area with many faunal segments restricted to it. The full impact of its physiographic isolation on the reptile fauna is not yet clear. We are well aware that there is yet much to be learned about the systematics of this fauna and anticipate that considerable information will come from the many systematic and ecological studies now being carried forward in the Great Basin.

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2. Works containing original descriptions of new taxons from the Great Basin or adjacent areas are annotated; the geographic location following the specific name is the type locality.

El Dorado County, California. 2) *Eutainia* [=*Thamnophis elegans*] *vagrans;* California. 3) *Ophibolus* [=*Lampropeltis getulus*] *boylii;* El Dorado County, California. 4) *Diadophis regalis;* Sonora, Mexico. 5) *Sonora semiannulata;* Sonora, Mexico. 6) *Rhinocheilus lecontei;* San Diego, California. 7) *Rena* [=*Leptotyphlops*] *humilis;* Valliecitas, California].

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NEW SPECIES OF NORTH AMERICAN *PITYOPHTHORUS* EICHHOFF (COLEOPTERA: SCOLYTIDAE)

Stephen L. Wood[1]

Several undescribed species of the large and difficult genus *Pityophthorus* have accumulated in recent years. Because of special interest in the biology and economic importance of these insects names must be made available for them. On the following pages twelve species are described as new to science; four are from the United States and eight are from Mexico.

Pityophthorus toralis, n. sp.

This species is allied to *anceps* Blackman and *alpinensis* Hopping, but is readily distinguished by the somewhat irregular rows of strial punctures, by the larger and more abundant strial and interstrial punctures, and by the deeper, wider declivital sulcus.

FEMALE.— Length 2.3 mm. (paratypes 2.1-2.4), 2.6 times as long as wide; body color very dark brown to black.

Frons broadly flattened between eyes from epistoma to well above eyes, with median half subconcave; gradually raised toward epistomal margin and with a conspicuous, distinctly elevated transverse epistomal process (much more conspicuous than in allied species); surface rather coarsely, closely punctured; vestiture fine, moderately abundant, uniformly covering entire flattened surface, but longer at margins. Eye and antenna as in allied species, except first suture of club more distinctly procurved.

Pronotum 1.04 times as long as wide, widest on basal third; sides arcuate behind, rather strongly constricted one-third from anterior margin; anterior margin rather narrowly rounded and bearing 10-12 serrations, those at center moderately large and sharp, decreasing to obscurity laterally; summit at middle, poorly developed; posterior area subshining, rather finely punctured, rim of each puncture subgranulate on side opposite summit. Vestiture short, inconspicuous, semirecumbent.

Elytra 1.8 times as long as wide; sides almost straight and subparallel on basal three-fourths, rather broadly rounded behind; striae not impressed, in irregular rows, the punctures moderately large and deep, distinct, smaller toward declivity; interstriae about two and one-half times as wide as striae, the surface with minute points and with moderately abundant irregular lines, the punctures almost equal in size and abundance to those of striae on anterior half, smaller and less abundant posteriorly. Declivity gradual, rather broadly sulcate; striae one and two obsolete, three minutely punctured; sutural interspace sharply, moderately raised and bearing a

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row of rather closely placed, minute, pointed granules, two more than twice as wide as one, flat, smooth, shining, three gradually raised and bearing a row of granules, the granules slightly larger than those of interspace one. Ninth interspace elevated. Subglabrous.

MALE.— Similar to female except frons convex above, transversely impressed below, with a low median carina from upper level of eyes to epistomal margin, the vestiture inconspicuous; pronotal asperities a little larger; strial and interstrial punctures a little smaller.

TYPE LOCALITY.— Beaver Creek, Logan Canyon, Utah.

TYPE MATERIAL.— The female holotype, male allotype, and 56 paratypes were collected at the type locality on June 14, 1947, from small branches of *Pinus flexilis*, by S. L. Wood.

The holotype, allotype and most of the paratypes are in my collection; other paratypes are in the collection of the U. S. National Museum.

Pityophthorus borrichiae, n. sp.

This representative of Blackman's group II is more nearly allied to *natalis* Blackman than to other known species, but is not closely related. From all other North American representatives of group II it differs by the convex, glabrous frons of the female, by the more slender body form, and by the reticulate posterior area of the pronotum.

FEMALE.— Length 1.2 mm. (paratypes 1.0-1.3), 2.8 times as long as wide; body color very dark brown.

Frons convex, very feebly, transversely impressed above epistoma, surface minutely strigose above, almost smooth below, with rather sparse, coarse, deep punctures over entire surface. Vestiture very short, sparse and inconspicuous except along epistoma. Eye emarginate; finely granulate. Antennal club small, the sutures straight and inconspicuous.

Pronotum 1.2 times as long as wide, widest at base; sides very weakly arcuate, very slightly converging anteriorly, rather broadly rounded in front; asperities fused to form two continuous concentric ridges in addition to the marginal row and one or two indefinite rows at summit; summit rather indefinite, in front of middle; posterior area finely reticulate, the punctures moderately large, very deep, sharp, not close. Glabrous, except at margins.

Elytra 1.7 times as long as wide; sides straight and subparallel on basal two-thirds, very broadly rounded behind; striae not impressed, in definite rows, the punctures rather large, deep, distinct; interstriae slightly wider than striae, impunctate, shining but marked by minute points and surface lines. Declivity steep, flattened; strial punctures not reduced, interspace two flat, impressed; interspaces one and three as wide as two, rather strongly raised and each bearing a row of rather large, rounded granules. Vestiture confined to sides and declivity; those on interspaces one and three short and stout, absent on two.

MALE.— Similar in all respects to female; distinguished only by segmentation of abdomen.

TYPE LOCALITY.— Key Largo, Florida.

TYPE MATERIAL.— The female holotype, male allotype, and 28 paratypes were collected at the type locality on June 25, 1951, from stems of *Borrichia arborescens* by S. L. Wood. Two other paratypes were taken at the same locality and date from *B. frutescens*.

The holotype, allotype and some paratypes are in my collection, other paratypes are in the Francis Huntington Snow Entomological Museum and the U. S. National Museum.

Pityophthorus atomus, n. sp.

This minute species is rather closely allied to *natalis* Blackman (group II), but is readily distinguished by the absence of minute points between punctures on the posterior areas of the thorax, by the smaller strial punctures, by the more narrowly rounded apex of the declivity, and by the very small size.

FEMALE.— Length 0.9 mm. (paratypes 0.85-1.25), 2.7 times as long as wide; body color dark reddish brown.

Frons flat on a rather small semicircular area from well above upper level of eyes to epistomal margin; surface shining, minutely, rather closely, finely punctured; vestiture consisting of fine moderately abundant, rather short hairs of equal length. Eye emarginate; finely granulate. Antennal club small, oval, almost devoid of setae except at margins, the sutures straight.

Pronotum 1.04 times as long as wide; sides on basal half almost straight and subparallel, rather broadly rounded in front; anterior margin armed by about a dozen small teeth; asperities arranged in two concentric rows with about two more partial, irregular rows at summit; summit at middle, feebly impressed behind; posterior areas smooth with a few obscure points evident, shining, punctures small, rather sparse, deep, becoming minute laterally; a sharp, narrow median ridge extending from summit about three-fourths of distance to posterior margin.

Elytra 1.8 times as long as wide; sides almost straight and subparallel on basal three-fourths, subacuminate behind; strial punctures in rows, the punctures small, rather deep; interstriae as wide as striae, almost smooth, with very minute points evident, impunctate. Declivity steep, bisulcate; strial punctures clearly evident but reduced somewhat in size; sutural interspaces moderately elevated and bearing a row of rather large rounded granules, interspace two not wider than one, impressed, flat, almost smooth; interspace three elevated, as high as one, bearing a row of about six rather large granules. Vestiture confined to declivity, moderately long, rather stout.

MALE.— Similar to female except frons feebly convex, more coarsely punctured, vestiture sparse; declivital bristles very stout.

TYPE LOCALITY.— Vera Cruz, Vera Cruz, Mexico.

TYPE MATERIAL.— The female holotype, male allotype and 11 paratypes were collected at the type locality on June 30, 1953, from a common small shrubby plant that was growing on sand dunes near the southwestern limits of the city.

The holotype, allotype and some paratypes are in my collection; other paratypes are in the collection of the Francis Huntington Snow museum.

Pityophthorus pusillus, n. sp.

This species is closely allied to *atomus*, but is distinguished by the deeper, wider declivital sulcus, by the shorter, less conspicuous vestiture of the female frons, and by the more coarsely punctured frons and more conspicuous transverse carina on the frons of the male.

FEMALE.— Length 1.1 mm. (paratypes 0.9 to 1.2), 2.9 times as long as wide; body color very dark reddish brown.

Frons flattened on a rather small semicircular area from well above upper level of eyes to epistomal margin; surface shining, finely, closely punctured; vestiture consisting of sparse, fine uniformly distributed rather short setae of equal length. Eye emarginate; finely granulate. Antennal club as in *atomus*.

Pronotum 1.06 times as long as wide; sides on basal half almost straight and subparallel, rather broadly rounded in front; anterior margin armed by about a dozen small teeth; asperities arranged in two concentric rows with about two more partial, irregular rows at summit; summit at middle, feebly impressed behind; posterior areas smooth, shining, with a few obscure points evident, punctures small, rather sparse, deep, becoming minute laterally; a sharp, narrow, median ridge extending from summit about three-fourths of the distance to posterior margin.

Elytra 1.9 times as long as wide; sides almost straight and subparallel on basal three-fourths, subacuminate behind; strial punctures in rows, the punctures small, rather deep; interstriae as wide as striae, almost smooth, with very minute points evident, impunctate. Declivity steep, bisulcate; strial punctures clearly evident but reduced in size; sutural interspaces moderately elevated and bearing a row of rather large rounded granules; interspace two much wider than one or three, strongly impressed, smooth; interspace three elevated, as high as one bearing a row of about six rather large granules. Vestiture confined to declivity, moderately long, rather stout.

MALE.— Similar to female except frons convex, transversely impressed, with a moderately developed transverse carina at upper level of eyes; declivital bristles very stout.

TYPE LOCALITY.— Nine miles south of Zimapan, Hidalgo, Mexico.

TYPE MATERIAL.— The female holotype, male allotype and 18 paratypes were collected at the type locality on June 23, 1953, at an elevation of 6100 feet, from branches of an unknown roadside shrub, by S. L. Wood.

The holotype, allotype and some paratypes are in my collection. Other paratypes are in the Francis Huntington Snow Museum and in the U. S. National Museum.

Pityophthorus paulus, n. sp.

The female of this species has the frons convex and devoid of special vestiture, as in *regularis* Blackman, but the declivity is much steeper and more strongly bisculate than in *regularis*.

FEMALE.— Length 1.4 mm. (paratypes 1.2-1.4), 2.9 times as long as wide; body color dark reddish brown.

Frons convex, median line indistinctly raised from vertex to epistoma; surface reticulate, becoming minutely rugose above, more nearly smooth below, the punctures coarse, moderately close below; vestiture short scanty, hairlike, similar to that of male. Eye emarginate; finely granulate. Sutures of antennal club straight, scarcely visible on middle third.

Pronotum about 1.1 times as long as wide; sides almost straight and subparallel on basal half, rather broadly rounded in front; anterior margin armed by a row of about a dozen, small, indistinct basally fused teeth; asperities fused to form three conscentric rows, a partial fourth row at summit; summit at middle, without transverse impression; posterior areas reticulate, indistinctly so behind summit, the punctures coarse, deep, moderately close, with median line impunctate. Glabrous.

Elytra 1.7 times as long as wide; sides straight and subparallel on basal two-thirds, very broadly rounded behind (almost straight on median half); striae not impressed, the punctures in rows, small, deep; interstriae almost smooth, a few points and lines evident, as wide as striae, impunctate. Declivity very steep, shallowly bisulcate; sutural interspaces rather wide, abruptly raised, bearing a row of about seven large granules; interspace two not wider than one, narrower above, flat below, evidently smooth; interspace three elevated, as high as one, and armed by a row of granules similar to those on one; striae one and two punctured throughout, one narrowly impressed at upper margin of declivity. Vestiture largely confined to sides and declivity, long, except blunt on declivital interspaces one and three, shorter on one.

MALE.— Similar to the female except frons very slightly, transversely impressed between upper level of eyes and epistoma; teeth on anterior margin of pronotum slightly larger; and lateral elevations of declivity a little higher.

TYPE LOCALITY.— Twenty-four miles northeast of Jacala, Hidalgo, Mexico.

TYPE MATERIAL.— The female holotype, male allotype and 18 paratypes were taken at the type locality on June 22, 1953, at an elevation of 4800 feet, from small branches of a roadside shrub (about four feet in height).

The holotype, allotype and some paratypes are in my collection;

other paratypes are in collections of the Francis Huntington Snow Museum and the U. S. National Museum.

Pityophthorus nanus, n. sp.

The declivity of this species is more nearly like that of *concentralis Eichhoff* than to other group II species known to me, although it is not closely related. The simple declivital sculpture and the frontal characters distinguish it from other species.

Female.— Length 1.5 mm. (paratypes 1.2-1.5), 3.0 times as long as wide; body color reddish brown.

Frons flattened on a semicircular area; very closely, rather coarsely, uniformly punctured; vestiture abundant, of uniform length, long, the longest setae about equal to length to antennal club. Eye and antenna as in allied species.

Pronotum 1.2 times as long as wide; sides almost straight and subparallel on basal half, rather narrowly rounded in front; anterior margin armed by a row of about twelve basally fused teeth; asperities fused to form four concentric rows, partial fifth and sixth rows are evident at summit; summit in front of middle, weakly impressed behind summit; posterior areas moderately shining, with some minute points, the punctures small, deep, less numerous along median line. Glabrous.

Elytra 2.0 times as long as wide; sides straight and subparallel on almost basal three-fourths, rather narrowly rounded behind; sutural striae feebly impressed, more strongly behind, the punctures moderately large, close; interstriae as wide as striae, smooth with a few obscure, minute points, impunctate. Declivity moderately steep, shallowly bisulcate, somewhat opalescent; strial punctures greatly reduced, but clearly evident; sutural interspace rather wide, abruptly, moderately elevated, smooth, unarmed; interspace two wider than one or three, almost flat, smooth; interspace three very gradually raised, slightly higher than one, unarmed, but with a few fine setiferous punctures. Vestiture confined to sides and declivity; very fine, rather short.

Male.— Similar to the female except frons convex above upper level of eyes, transversely impressed below, the impression formed abruptly at upper level of eyes, transversely impressed below, the impression formed abruptly at upper level of eyes creating an almost carina-like callus; and teeth on anterior margin of pronotum slightly larger.

Type Locality.— Totalapan, Oaxaca, Mexico.

Type Material.— The female holotype, male allotype, and seven paratypes were taken at the type locality on July 7, 1953, at an elevation of 3300 feet, from a broken branch of an unknown tree.

The holotype, allotype, and some paratypes are in my collection; other paratypes are in collections of the Francis Huntington Snow Museum and the U. S. National Museum.

Pityophthorus dolus, n. sp.

This species is more closely allied to *monophyllae* Blackman than to other known species, but is distinguished by the coarse pronotal and elytral punctures, by the distinct declivital punctures, by the impressed female frons, and by the longer, lower frontal carina of the male.

FEMALE.— Length 1.3 mm. (paratypes 1.2-1.4), 2.8 times as long as wide; body color very dark brown.

Frons flattened from eye to eye, gradually, transversely impressed above epistoma; surface rather sparsely punctured, the punctures distinctly larger than in *monophyllae;* vestiture as in *monophyllae.*

Pronotum very slightly longer than wide; similar to but more broadly rounded in front than in *monophyllae;* anterior margin bearing four serrations, the median pair rather widely set but with their bases almost touching; posterior area subshining, with minute points, the punctures rather large, deep, close; vestiture evident only at sides.

Elytra 1.8 times as long as wide; sides almost straight and subparallel on basal two-thirds, rather narrowly rounded behind; striae not impressed, the punctures small, in irregular rows; interstriae almost smooth, subshining, with a few scattered punctures equal in size to those of striae. Declivity moderately steep, convex; first striae strongly impressed, the punctures only slightly smaller than on disc, other striae not impressed but the punctures strongly reduced; sutural interspace abruptly, slightly elevated, unarmed, two and three smooth, three with minute punctures. Vestiture consisting of minute strial and interstrial hairs, sometimes longer at sides.

MALE.— Similar to the female except frons weakly convex, with a fine, low median carina on lower half; punctures of pronotum and elytra smaller; punctures on declivity greatly reduced, scarcely visible.

TYPE LOCALITY.— McCloud, Siskiyou County, California.

TYPE MATERIAL.— The female holotype, male allotype and 24 paratypes were taken at the type locality on June 14, 1961, from twigs of *Pinus ponderosa*, by S. L. Wood, D. E. Bright, and J. B. Karren.

The holotype, allotype and most of the paratypes are in my collection; other paratypes are in the U. S. National Museum.

Pityophthorus limatus, n. sp.

This species is rather closely allied to *watsoni* Schedl, but is readily distinguished by the much smaller pronotal and elytral punctures, by the more broadly rounded apex of the elytra, and by the very different frontal vestiture of the female.

FEMALE.— Length 1.8 mm. (paratypes 1.4-2.1), 3.0 times as long as wide; body color reddish brown to brown.

Frons flattened on a subcircular area from vertex to epistoma, densely, finely punctured; vestiture erect, dense, of uniform length, each hair scarcely longer than a distance equal to one-half width of upper part of eye. Eye and antenna as in allied species.

Pronotum 1.1 times as long as wide; sides almost straight and subparallel on posterior half, rather broadly rounded in front; anterior margin armed by twelve moderately large, pointed serrations; summit at middle, moderately impressed behind summit; posterior area smooth, subshining, with numerous very minute points, punctures small, deep, not close. Glabrous, except at margin.

Elytra 1.9 times as long as wide; sides straight and subparallel on basal three-fourths, rather narrowly rounded behind; sutural striae feebly impressed on posterior half; strial punctures in slightly irregular rows, small, shallow; interspaces subshining, with abundant, minute, indistinct points, punctures absent. Declivity moderately steep, bisulcate; all punctures obsolete; sutural interspace rather abruptly elevated, somewhat inflated on lower fourth, armed by a row of small tubercles; sulcus rather wide, very smooth, shining; lateral margins moderately elevated and bearing a row of about six small tubercles.

Male.— Similar to female except frons convex, with a broad somewhat indefinite transverse carina just above upper level of eyes, finely punctured below, rather coarsely punctured above.

Type Locality.— Sanford Canyon, Dixie National Forest, Utah.

Type Material.— The female holotype, male allotype and 24 paratypes were collected at the type locality on June 22, 1960, from branches of *Picea pungens*, by S. L. Wood. Ten additional paratypes were taken at Parowan Canyon, Utah, on June 20, 1960, from the same host and collector. Four paratypes are from McKee Draw, Ashley National Forest, Utah, taken June 22, 1960, from the same host and collector.

The holotype, allotype and most of the paratypes are in my collection; other paratypes are in the U. S. National Museum.

Pityophthorus elatinus, n. sp.

This unique species belongs to Blackman's group V, but it represents a subgroup previously unknown to me. The small antennal club and absence of interstrial punctures resemble those of species in group VII, but the male carina and the declivity indicate a closer relationship to group V.

Female.— Length 2.1 (paratypes 2.0-2.2), 2.9 times as long as wide; body color very dark brown, the elytra lighter in color.

Frons flattened from eye to eye, from epistoma to well above eyes; surface smooth with sparse very fine punctures; vestiture short and sparse in central area, long and abundant at margins, the long setae equal in length or slightly exceed diameter of flattened area. Eye emarginate; finely granulate. Antennal club 1.2 times as

long as wide, segments two and three equal in width; first suture straight, second weakly arcuate.

Pronotum 1.03 times as long as wide; sides almost straight and subparallel on basal half, moderately constricted behind the broadly rounded anterior margin; anterior margin armed by about a dozen low serrations; summit at middle, rather strongly impressed behind summit; posterior and lateral areas irregular, evidently granulose-reticulate with minute points intermixed, most punctures replaced by small, rounded isolated granules behind summit, finely and irregularly punctured in lateral areas. Vestiture short, inconspicuous except at sides.

Elytra 1.8 times as long as wide; sides straight and subparallel on basal two-thirds, tapered posteriorly, then broadly rounded behind; sutural striae weakly impressed, others not impressed, the punctures in definite rows, small, close, shallow; interstriae about twice as wide as striae, smooth, impunctate except at margin of declivity. Declivity steep, narrowly sulcate; punctures of first and second striae obsolete; sutural interspaces abruptly, moderately elevated, more strongly below, armed by about ten minute granules (some may take the form of punctures); interspace two broad, impressed, smooth; interspace three strongly elevated on upper half, higher than one, forming a small hump about middle of declivity causing the sulcus to be narrow above, wider below, some punctures on elevated portion minutely indefinitely granulate. Elytra glabrous except at sides.

Male.— Similar to female except frons convex, rather finely punctured, with a fine, low, acute median carina on lower half; antennal club narrower, 1.3 times as long as wide; declivital margins much more strongly elevated, unarmed, the sutural interspace bearing a row of moderately long, stout semirecumbent setae that extend laterally from their bases; interspace three bearing a row of short stout setae on upper third of declivity.

Type Locality.— Twenty-five miles west Ciudad Hidalgo, Michoacan, Mexico.

Type Material.— The female holotype, male allotype and five paratypes were taken on July 16, 1953, at an elevation of 8900 feet, from transverse galleries in branches of an *Abies* species, by S. L. Wood.

The holotype, allotype and some paratypes are in my collection; other paratypes are in the Francis Huntington Snow Museum and in the U. S. National Museum.

Pityophthorus abiegnus, n. sp.

Evidently this species is more closely allied to *immanis* Blackman than to other known species, but is distinguished by the smaller size, by the less numerous interstrial granules on the disc, and by the more regularly spaced sutural granules on the declivity.

Female.— Length 2.2 mm. (paratypes 2.1-2.4), 2.6 times as long as wide; body color very dark brown.

Frons planoconvex over a broad area, finely, rather closely punctured; vestiture fine, long uniformly distributed, setae at periphery only slightly longer than at center. Eye finely granulate; emarginate. Antennal club small, widest through second segment, about 1.2 times as long as wide.

Pronotum equal in length and width, widest at base, the sides feebly arcuate and converging slightly toward the broadly rounded anterior margin, a definite lateral constriction just behind anterior margin; anterior margin armed by about twelve low serrations; summit at middle, moderately impressed behind summit; posterior and lateral areas subshining, the surface smooth with very abundant minute points, the punctures rather large, close, deep, impunctate along median line. Vestiture sparse, minute, inconspicuous.

Elytra 1.7 times as long as wide; sides straight and subparellel on basal two-thirds, then slightly tapered, and finally broadly rounded behind; surface subshining, minutely, indefinitely reticulate; sutural striae weakly impressed, others not at all, the punctures in rows, rather small, distinct, reduced in size on anterior one-fourth; interstriae as wide as striae, each with about two or three punctures irregularly placed. Declivity steep, bisulcate; punctures of striae one and two obsolete; sutural interspace abruptly, moderately elevated and bearing about ten widely spaced, minute granules; interspace two wider than one or three, impressed, almost smooth; interspace three moderately elevated, much higher than one, and bearing a row of about six widely spaced, coarse teeth. Vestiture hairlike, largely confined to sides.

Male.— Similar to female except frons convex, with a well developed transverse carina at upper level of eyes, a median carina also indicated; the surface coarsely punctured; pronotal and declivital armature more coarsely developed, with a partial double row of tubercles near base of declivity on interspace three; a row of very short, stout setae on upper half of third declivital interspace.

Type Locality.— Four miles west of Rio Frio, Mexico, Mexico.

Type Material.—The female holotype, male allotype and 10 paratypes were taken at the type locality on July 14, 1953, at an elevation of 9800 feet, from branches of an *Abies* species, by S. L. Wood.

The female holotype, male allotype and some paratypes are in my collection, other paratypes are in collections of the Francis Huntington Snow Museum and the U. S. National Museum.

Pityophthorus cristatus, n. sp.

This odd species probably should be placed in Blackman's group VII, but it is not at all closely related to any known species. The sexes are almost indistinguishable, both have the declivity oblique and excavated with the lateral margins acutely elevated from the top of interspace two, around the elytral apex, to the opposite interspace two.

FEMALE.— Length 1.6 mm. (paratypes 1.5-1.9), 2.6 times as long as wide; body color dark reddish brown.

Frons convex, somewhat flattened, surface coarsely punctured above and at sides, somewhat more finely punctured below on median half; vestiture inconspicuous, consisting of a few scattered hairs of medium length. Eye emarginate; finely granulate. Antennal club widest through second segment, sutures one and two weakly procurved.

Pronotum 1.05 times as long as wide; sides almost straight and subparallel on basal half, weakly constricted one-third from the broadly rounded anterior margin; asperities confused, summit at middle, transverse impression behind summit rather well developed; anterior margin armed by a row of about ten low teeth (somewhat irregular in size); posterior areas subshining, reticulate, the punctures deep, close, rather coarse. Vestiture confined to marginal areas.

Elytra 1.7 times as long as wide; sides straight and subparallel on basal two-thirds then converging very slightly to declivital margin, very broadly rounded behind (median portion almost straight); strial and interstrial punctures confused, the punctures moderately large and deep; surface subshining, indistinctly reticulate. Declivity oblique, excavated; an acutely, very strongly elevated subserrulate margin extending above from second interspace to apex, the area encompassed roughly obovate; the broad excavated area with strial punctures indistinct but evident, in rows, sutural interstriae moderately elevated and bearing a row of close, rounded granules. Vestiture on sides and particularly on declivital margin moderately long and abundant; minute in declivital excavation.

MALE.— Similar to female except frons very slightly more evident.

TYPE LOCALITY.— Nine miles north of Perote, Vera Cruz, Mexico.

TYPE MATERIAL.— The female holotype, male allotype and four paratypes were taken at the type locality on June 28, 1953, at an elevation of 7200 feet from branches of *Pinus*, by S. L. Wood; two paratypes were collected 19 miles east of Tulancingo, Hidalgo, Mexico, on June 24, 1953, from the same host and collector; and six paratypes were taken at Las Vigas, Vera Cruz, Mexico, on June 5, 1962, from *Pinus*, by R. Coronado.

The holotype, allotype and some paratypes are in my collection; other paratypes are in collections of the Francis Huntington Snow Museum and the U. S. National Museum.

Pityophthorus hylocuroides, n. sp.

This species is allied to *virilis* Blackman (group VII) but differs by the steeper, flattened, almost *Hylocurus*-like declivity of the male, by the less deeply sulcate elytra of the female, and by the presence of pointed granules on the sutural interspace of the declivity (rarely one or two granules on lower third in *virilis*).

MALE.— Length 1.4 mm. (paratypes 1.1-1.5), 2.7 times as long as wide; body color dark reddish brown.

Frons convex above upper level of eyes, abruptly impressed and longitudinally concave below; surface smooth and shining with rather large, close, deep punctures; vestiture inconspicuous, sparse. Eye and antenna as in *virilis*.

Pronotum equal in length and width; sides almost straight and subparallel on basal half, broadly rounded in front; asperities arranged in three concentric rows between anterior margin and summit, about two indefinite partial rows at summit; anterior margin armed by about ten indefinite low teeth; transverse impression behind summit very poorly developed; posterior areas shining, with abundant minute points. the punctures rather coarse, deep, moderately close. Vestiture confined to marginal areas.

Elytra 1.8 times as long as wide; sides straight and subparallel to base of subtruncate declivity, broadly obtuse behind; striae not impressed, the punctures rather small, deep; interstriae about as wide as striae, shining, smooth except for a few minute lines and largely obliterated minute points, impunctate. Declivity, except between sutural striae, abrupt, very steep, almost subtruncate; second and third striae evident on upper half only, their punctures gradually decreasing in size; sutural interspace moderately, uniformly elevated to apex and bearing about eight small pointed tubercles; interspace two impressed, widened, impunctate, shining, elevated laterally; interspace three rather narrowly, moderately elevated from upper margin to middle of declivity and bearing four to six rather large, pointed tubercles; apical and lateral margins abruptly elevated forming three-fourths of a circle, terminated above the third interspaces. Vestiture sparse, inconspicuous.

FEMALE.— Similar to male except frons flattened from epistoma to well above eyes and finely closely punctured, bearing uniformly distributed rather long hair of equal length (as in *virilis*); declivity not as abrupt, the apical and lateral margins not elevated.

TYPE LOCALITY.— Eleven miles northeast of Jacala, Hidalgo, Mexico.

TYPE MATERIAL.— The male holotype, female allotype and 12 paratypes were collected at the type locality on June 22, 1953, at an elevation of 5100 feet, from branches of *Rhus trilobata* (or a very closely related species), by S. L. Wood.

The holotype, allotype and part of the paratypes are in my collection; other paratypes are in collections of the Francis Huntington Snow Museum and the U. S. National Museum.

MITES FROM MAMMALS AT THE NEVADA TEST SITE[1]

Dorald M. Allred and Morris A Goates

During ecological studies at the nuclear test site north of Mercury, Nye County, Nevada (Allred, Beck and Jorgensen, 1963), mites were recovered from many vertebrates. Data on some collections were published by Allred (1962, 1962a, 1964), Allred and Beck (1962), Goates (1963), and Allred and Goates (1964). Additional collections represent eleven new mite-host associations, ten new distribution records for the test site and apparently for Nevada, and an unusual record of erythraeid mites of the genus *Caeculisoma* crawling on bats. These larvae are normally parasitic on arthropods. Although other arthropods were not found on the bats in our study, dipterous or other parasites may have left the hosts before we examined them.

We are grateful to James M. Brennan and Conrad E. Yunker, Rocky Mountain Laboratory, and Frank J. Radovsky, Hooper Foundation, for identification and verification of some of our mites. Some mites not reported here represent several undescribed species. These are being studied by these men who likely will describe them in subsequent publications.

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1. This study was supported (in part) by Contract AT(11-1)786 between the U. S. Atomic Energy Commission and Brigham Young University.

TABLE 1. Mite-host associations at the Nevada Test Site.

Mite	Stage	Host	Date of Collection
MESOSTIGMATA			
Androlaelaps leviculus	1♂ 1♀	*Peromyscus* sp.	Oct
Brevisterna utahensis	1♀	*Peromyscus crinitus*	Nov
Dermanyssus becki	2pn 8dn 3♂ 3♀	*Peromyscus crinitus*	Apr Jun Jul
**Eubrachylaelaps circularis*	3♀	*Peromyscus truei*	June Jul
**Eubrachylaelaps debilis*	2♀	**Peromyscus truei*	Mar
	1♀	*Peromyscus crinitus*	Jun
**Eubrachylaelaps hollisteri*	35♀	*Peromyscus crinitus*	Jan Jun Jul Oct Nov
Haemogamasus pontiger	1♀	**Peromyscus crinitus*	Nov
Haemolaelaps glasgowi	1pn 2♀	*Peromyscus maniculatus*	Jun Nov
	4♀	*Peromyscus truei*	Apr May Jul
	1pn 4dn 3♂ 41♀	*Thomomys umbrinus*	Jan Mar May
**Hirstionyssus carnifex*	1♀	**Peromyscus crinitus*	Jun
Ischyropoda armatus	2♀	**Peromyscus crinitus*	Jun
Kleemania sp.	28♀	**Peromyscus crinitus*	Jun
	1♀	*Peromyscus maniculatus*	Apr
	3♀	*Peromyscus truei*	Mar

Table 1 continued.

	1 ♀	*Thomomys umbrinus*	Mar
**Steatonyssus antrozoi*	6 ♀	*Antrozous pallidus*	Jul
TROMBIDIFORMES			
**Caeculisoma* sp.	7 la	*Pipistrellus hesperus*	Nov
	2 la	*Corynorhinus townsendii*	Nov
**Euschöngastia cordiremus*	2 la	*Peromyscus maniculatus*	Nov
Euschöngastia criceticola	27 la	*Peromyscus maniculatus*	Feb Jul
	3 la	**Sorex tenellus*	Aug
Euschöngastia decipens	10 la	*Perognathus parvus*	Sept Oct
Euschöngastia fasolla	2 la	**Eutamias dorsalis*	Apr
**Euschöngastia lanei*	1 la	*Peromyscus maniculatus*	Jul
**Odontacarus hirsutus*	1 la	**Bassariscus astutus*	Sept
Odontacarus linsdalei	1 la	**Peromyscus maniculatus*	Nov
Sasacarus sp. "w"	1 la	**Peromyscus* sp.	Aug
Trombicula arenicola	2 la	**Sorex tenellus*	Aug
	5 la	*Spermophilus tereticaudus*	Aug
**Whartonia perplexa*	1 la	*Antrozous pallidus*	Jul

*Mite: new distribution record for Nevada; host: new mite-host association.

ECTOPARASITES OF MAMMALS FROM OREGON

Charles G. Hansen[1]

Ectoparasites from 451 small mammals were collected while making an ecological study in the Steen's Mountains area in Harney County, Oregon. The mammals were captured in snap-traps, and individuals of the same species were placed in plastic bags and etherized to kill their ectoparasites. The bags and carcasses were then examined for invertebrates. Ectoparasites were placed in small vials containing 70 per cent ethyl alcohol and labeled as to place, date, collector, and host. The mammals and number examined are listed below.

Sorex preblei Jackson, 1
Sorex vagrans monticola Merriam, 8
Sorex palustris navigator (Baird), 6
Myotis lucifugus carissima Thomas, 2
Myotis volans interior Miller, 3
Lasionycteris noctivagans (Le Conte), 1
Antrozous pallidus cantwelli Bailey, 12
Mustela frenata nevadensis Hall, 2
Citellus beldingi crebrus Hall, 3
Citellus leucurus leucurus (Merriam), 3
Citellus lateralis trepidus (Taylor), 3
Eutamias minimus scrutator Hall and Hatfield, 1
Eutamias (*amoenus* and/or *minimus*), 23
Thomomys talpoides quadratus Merriam, 3
Perognathus parvus parvus (Peale), 6
Dipodomys ordii columbianus (Merriam), 24
Dipodomys microps preblei (Goldman), 1
Onychomys leucogaster fuscogriseus Anthony, 11
Peromyscus maniculatus sonoriensis (Le Conte), 211
Neotoma lepida nevadensis Taylor, 5
Neotoma cinerea alticola Hooper, 4
Microtus montanus montanus (Peale), 53
Microtus longicaudus mordax (Merriam), 46
Lagurus curtatus pauperrimus (Cooper), 11
Zapus princeps major Preble, 6
Ochotona princeps taylori Grinnell, 1
Sylvilagus nuttalli nuttalli (Bachman), 1

Assistance was given by P. W. Oman, and identification of the parasites was made by C. F. W. Muesebeck, E. W. Baker, A. Rud-

1. Desert Game Range, Las Vegas, Nevada.

nick, and A. Stone of the Insect Identification and Parasite Introduction Section of the United States Department of Agriculture; and by F. C. Bishopp and R. I. Sailer of the Oscar Johnston Cotton Foundation at Brownsville, Texas. Mounted and unmounted specimens of the parasites are housed in the United States National Museum and the Oregon State University entomological museum.

Identification of the hosts was made by the author in the field at the time of collection. Consequently, separation of the two species of *Eutamias* was not attempted where their ranges overlapped, and these are referred to in the tables as *Eutamias* sp.

I am indebted to Drs. D Elden Beck and Dorald M. Allred, Zoology and Entomology Department of Brigham Young University whose encouragement and assistance aided greatly in the preparation of the manuscript.

Tables 1 to 5 present the species and numbers of individuals of each parasite and their host relationships. When only the genus, family or order are given, the parasite represented an undetermined species, or a specialist was not available to make specific identifications of that particular organism.

Discussion

Analysis of the tables reveals several interesting host-parasite relationships. Mice of *Microtus montanus* possessed the greatest number of species of mites of any mammal studied. These mice also were next in frequency to deer mice, *Peromyscus maniculatus*, with reference to the numbers of species of fleas they possessed. Although more hosts of these two species were examined than other mammals, sufficient numbers of some of the others were taken to be indicative of their parasite fauna.

Most parasites were not widely distributed in relationship to host species, and when found on more than one or two hosts usually were found only in small numbers. A few, however, were widely distributed and in some abundance. These were the mites *Haemogamasus ambulans* and *Haemolaelaps glasgowi*, tick *Dermacentor andersoni*, and fleas *Catallagia decipiens*, *Megabothris abantis*, *Meringis hubbardi*, and *Monopsyllus wagneri*.

Table 1. Host relationships and numbers of mites from mammals of Harney County, Oregon.

Mite	Host: *Antrozous pallidus*	*Eutamias* sp.	*Lagurus curtatus*	*Lasionycteris noctivagans*	*Microtus longicaudus*	*Microtus montanus*	*Myotis lucifugus*	*Neotoma lepida*	*Onychomys leucogaster*	*Perognathus parvus*	*Peromyscus maniculatus*	*Sorex palustris*	*Sorex preblei*	*Sorex vagrans*	*Thomomys talpoides*	*Zapus princeps*
Balaustium sp.						1										
Bdella sp.			1													
Dermacarus sp.						1										
Erythres sp.						1										
Eubrachylaelaps crowei						1			1							
Eulaelaps stabularis						3					1					
Haemogamasus ambulans			2		3	3			27		3			2	6	1
Haemogamasus liponyssoides					1	1										
Haemogamasus mandschuricus									1							
Haemogamasus pontiger								4								
Haemolaelaps (prob.) *casalis*						1		1	1							
Haemolaelaps glasgowi		1	9		10	24			4	11	13	1	1	1		
Hirstionyssus arcuatus											1					
Hirstionyssus isabellinus					1	1								1		
Hirstionyssus obsoletus											1					
Hirstionyssus sp.					1	1				4		1				
Ischoronyssus sp.				1			1									
Laelaps alaskensis			1			3			1							
Laelaps pachypus					3	21										
Leptus sp.						1										
Macrocheles sp.		1			1	1				1	2					
Parasitus sp.					1	2		1						1		

Table 1 continued.

Poecilochirus sp.	1	1		1		
Pygmephorus sp.				1		
Resinacarus sp.		1				
Spinturnix (prob.) *americanus*			1			
Spinturnix sp.	1					
Phytoseiidae sp.			1			
Trombiculidae sp.	1	1			2	
Unknown			2			

Table 2. Host relationships and numbers of ticks from mammals of Harney County, Oregon.

Host	Tick *Dermacentor andersoni*	*Haemaphysalis l.-palustris*	*Ixodes angustus*	*I. kingi*	*I.* sp.
Citellus lateralis	16				
Eutamias sp.	11				
Microtus longicaudus	10				
M. montanus	30				
Neotoma cinerea	5		14		
N. lepida	1				
Onychomys leucogaster				1	
Perognathus parvus	8				
Peromyscus maniculatus	51				4
Sorex palustris	1				
S. vagrans					6
Sylvilagus nuttallii	4	22			

Table 3. Host relationships and numbers of lice from mammals of Harney County, Oregon.

Louse / Host	*Dipodomys ordii*	*Eutamias* sp.	*Microtus longicaudus*	*M. montanus*	*Myotis lucifugus*	*Neotoma cinerea*	*N. lepida*	*Perognathus parvus*	*Peromyscus maniculatus*	*Sorex palustris*	*Thomomys talpoides*
Anoplura											
Fahrenholzia pinnata	1							37			
Hoplopleura acanthopus			52	37	1				2		
H. arboricola		5									
H. (prob.) *erratica*		2									
H. hesperomydis									35		
Neohaematopinus inornatus						11	2				
N. pacificus		5									
Polyplax (prob.) *abscinssa*				4							
P. auricularis									43	3	
P. spinulosa				1							
Mallophaga											
Geomydoecus thomomys											7
Strigiphilus ceblebrachys									1		

Table 4. Host relationships and numbers of bedbugs and biting flies from mammals of Harney County, Oregon.

Parasite / Host	*Antrozous pallidus*	*Microtus longicaudus*	*Myotis lucifugus*	*M. volans*
Hemiptera				
Cimex piloselis				1
Diptera				
Basilia forcipata			9	2
B. antrozoii	9			
Simulium aureum		1		

Table 5. Host relationships and numbers of fleas from mammals of Harney County, Oregon.

Flea \ Host	*Citellus beldingi*	*C. lateralis*	*C. leucurus*	*Dipodomys microps*	*D. ordii*	*Eutamias minimus*	*E.* sp.	*Lagurus curtatus*	*Microtus longicaudus*	*M. montanus*	*Mustela frenata*	*Neotoma cinerea*	*N. lepida*	*Ochotona princeps*	*Onychomys leucogaster*	*Perognathus parvus*	*Peromyscus maniculatus*	*Sorex palustris*	*S. preblei*	*S. vagrans*	*Thomomys talpoides*	*Zapus princeps*
Callistopsyllus terinus																	4					
Catallagia decipiens								5	7	24							28			5		
Corrodopsylla curvata										1							1	5	1			
Foxella ignota															7						11	
Hoplopsyllus anomalus			15																			
Hystrichopsylla dippiei									1													
H. schefferi											1											
Malaraeus euphorbi																	1					
M. telchinum									5	1					2		1					

Table 5 continued.

Megabothris abantis									55	42							8	1				18
M. asio										2												
M. clantoni								44		3												
M. quirini					1											1						1
Meringis hubbardi		1			9					10					42	16	7					
M. parkeri	1				12										28		3					
M. sp.				1																		
Monopsyllus eumolpi						18	63			1		2					1					
M. wagneri				1				1	10	7	1	8	1	1	1	1	347			2		3
Neopsylla inopina								1	1													
Opisocrostis tuberculatus	1															1						
Opisodasys keeni																	35					
Orchopeas sexdentatus												42	9									
Oropsylla idahoensis	8	1					2	2			1	2					1				1	
Peromyscopsylla selenis									26	13												
Thrassis gladiolis			35												11							
T. pandorae	1						1															

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SOME ETHIOPIAN LACEBUGS (HEMIPTERA: TINGIDAE)

Carl J. Drake[1] and Bob G. Hill[2]

The present paper deals with a small lot of miscellaneous Tingidae collected in Ethiopia during the years 1963-64 by the junior author. This collection comprises 15 species segregated into 12 genera, including 1 new genus and species and 4 undescribed species in other genera. Each species, as it was picked from the leaves of its host plant, was placed in a separate vial containing 80 percent alcohol. An effort was also made to pick nymphs as well as adults from the same leaves. Thus each vial contains numerous nymphal and imaginal morphs of one species. The last two immature stages provide good diagnostic characters.

One of the field notes is of unusual biological interest. On the road to Addis Ababa from Dire Dawa, August 30, 1963, numerous specimens of a new species, *Haedus cirratus* (fig. 2) were collected on a single host plant of *Grewia mollis*. To obtain more specimens of this undescribed species, another trip was made, February 19, 1964, to the same individual plant. On the latter trip, besides a long series of *H. cirratus*, several specimens of a new genus and species, *Afrotingis eumenes* (fig. 3), were taken on this particular plant. The illustrations depict the marked differences in structure and habitus of species found breeding on a single individual plant.

The host plants were identified by Dr. William Berger, plant taxonomist, Haile Sellassie I University; all plant names are listed in accordance with "A glossary of Ethiopian plant names" (Dublin Univ. Press, Ltd., 1963). The fine drawings of the lacebugs were executed by Mrs. Richard C. Froeschner, Arlington, Virginia. In the descriptions, 80 microunits are equivalent to 1 millimeter. The holotypes and allotypes of the new species are in the Drake Collection (USNM) and paratypes are in the Haile Sellassie I University and collections of the authors. For generic and specific references, see the Catalog of the Lacebugs of the World (Drake and Ruhoff 1964).

1. Smithsonian Institution, Washington, D. C.
2. Haile Sellassie I University, Dire Dawa, Ethiopia.

The collection comprises the species listed below, including records of breeding hosts:

Plerochila australis (Distant) (fig. 1)

Alemaya, Aug. 8, and Sept. 3, 1963 and Feb. 19, 1964, nymphs and adults, on olive tree, *Olea africana*. This species is a pest of cultivated olive, *Olea europaea*, and is widely distributed in Africa and islands in the Indian Ocean.

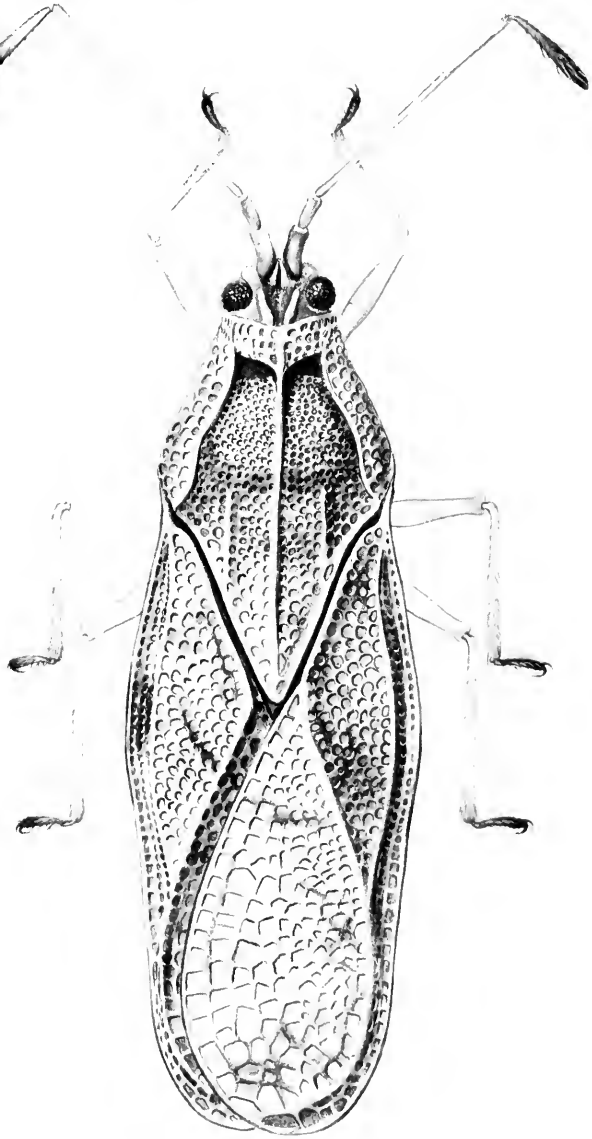

Fig. 1. *Plerochila australis* (Distant)

Compseuta latipennis Horváth

Collected 45 kilometers southeast of Harar on the road to Jigiga, May 25, 1963, alt. 1550 m., breeding on *Cordia ovalis*.

Compseuta ornatella teres Drake

Jimma, July 25, 1963, on *Premna* sp. The varieties of *ornatella* (Stal) show differences in the dimensions of the lateral carinae.

Elasmotropis testacea (Herrich-Schaeffer)

Alemaya, Dec. 17, 1963, on *Echinops spinosus* L. Several varieties of this species have been described.

Horvathula uniseriata (Horváth)

Alemaya, Aug. 26, 1963, on *Cordia africana* Lam. The members of the plant genus *Cordia* serve as breeding hosts for species belonging to several genera of lacebugs in both the Old and New Worlds.

Urentius hystricellus (Richter)

Alemaya, March 31, 1963; Dire Dawa, Aug. 13, 1961, breeding on *Solanum incannum* and *Solanum melongena* (eggplant, a common host). *U. aegyptiacus* Bergevin of Egypt is a synonym of it. This very spiny lacebug is also recorded from Kenya, Senegal, Nigeria, Sudan, Uganda, Egypt, Southern Rhodesia, Ceylon, and India.

Urentius euonymus Distant

Dire Dawa, Aug. 29, 1963, on *Hibiscus aponeurus* S. & H. Known also from Algeria, Egypt, Sudan, Ceylon, India, Israel, Syria, and Turkey. Several synonyms are recorded in the literature.

Eteoneus congolensis Schouteden

Alemaya, Aug. 26, 1963, on *Nuxia congesta* R. Br.

Cysteochila tombeuri Schouteden

Alemaya, Sept. 3, 1963, on *Cissus* sp.

Naochila kivuensis (Schouteden)

South face of Gara Mullata Mts., 50 km. west of Harar, alt. 1100 meters; on *Acanthus eminens* C. B. Clarke.

Naochila engys, n. sp.

Small, oblong, testaceous with head, pronotum, paranotum, and the tumid elevation of each elytron plus many veinlets blackish fuscous. Body beneath brown to blackish fuscous. Antennae testaceous. Legs testaceous with a fairly wide fuscous band near the middle of each hind femur, all tarsi dark fuscous. Length ♂ and ♀ 1.90 mm.; width (elytra) 0.85 mm.

Head very short, armed with five testaceous spines; frontal spines moderately long, porrect; hind pair much longer, stouter, appressed, extending forward almost to fore margins of eyes; buc-

culae wide, closed in front, finely areolate. Rostrum testaceous with dark tip, extending slightly beyond sternum; sternal laminae low, areolate, usually deep black. Ostiole and ostiolar canal not visible. Antenna long, very slender, indistinctly pubescent, fourth segment sparsely hairy and slightly swollen. Measurements: segment I, 6; II, 5; III, 42; IV, 14.

Pronotum moderately convex, coarsely punctate, tricarinate; median carina long, elevated anteriorly on pronotal disc, uniseriate, the areolae fairly large; lateral carinae long, less raised than median, concealed on each side of pronotal disc by reflexed paranotum, slightly divergent posteriorly; paranotum large, reflexed, inflated, space between outer margin of each paranotum and median carina about the width of an areola; each paranotum with two prominent, longitudinal ridges, the outer ridge less prominent and near humeral angle, each ridge formed by longitudinally elevated areolae. Legs long, slender, inconspicuously pubescent. Ostiole and ostiolar canal not visible.

Elytra slightly wider and longer than abdomen; sutural areas overlapping each other with apices resting jointly rounded in repose; hypocostal lamina narrow, uniseriate; costal area composed of one row of moderately large, hyaline areolae, the crossveins thick and blackish fuscous; subcostal area two areolae deep in front of outward projection of discoidal area and then three or four cells deep behind it; discoidal area approximately reaching middle of elytron, tapering anteriorly, almost triangular in outline, elevated, and widely truncate at apex, almost four or five areolae deep, convexly projecting outward in apical third into subcostal area; sutural area large. Hind pair of wings slightly longer than abdomen, smoky, functional.

HOLOTYPE ♂ and ALLOTYPE ♀, both macropterous, on *Cordia ovalis*, about 42 km. west of Dire Dawa, on road to Addis Ababa, altitude 1,100 m., Dec. 22, 1963. PARATYPES: 10 specimens, collected with type; 10 specimens, Alemaya, Ethiopia, on *Ehretia cymosa*, April 6, 1964, Bob G. Hill; 12 specimens, North Transvaal, South Africa, on *Ehretia rigida*, Dec. 16, 1964, J. Paliatseas.

Separated from *N. kivuensis* Schouteden by its much smaller size, narrower form, and longitudinally ridged paranota; femora may or may not be banded with blackish fuscous, sometimes only one or two pairs banded. In *N. kivuensis*, the paranota are inflated but not ridged and the outer margins meet on the median line of pronotal disc above the median carina.

Dictyla litotes, n. sp.

Small, oblong, slightly brownish testaceous with pronotal disc, narrow, basal margin of each paranotum plus adjacent part of propleuron, all coxae, and fourth segments of each antenna blackish fuscous. Cephalic spines testaceous. Length 2.52 mm., width (elytra) 0.93 mm.

Head very short, not much produced in front of eyes, armed with five testaceous spines, the three frontal spines porrect and hind pair appressed; rostrum extending to end of mesosternum; sternal laminae of rostral sulcus testaceous, uniseriate, slightly divergent posteriorly on mesosternum, widely separated and cordate on metasternum, closed behind; bucculae areolate, ends meeting in front. Metapleural orifice and ostiolar canal not visible. Antennae rather short, slender, segment III sparsely beset with short, setal hairs, measurements: segment I, 6; II, 5; III, 42; IV, 14.

Pronotum moderately convex, punctate, completely covered on each side of pronotal disc by reflexed paranotum; lateral carinae visible only on backward, triangular projection of hind margin of pronotum; all carinae low, non-areolate, the lateral pair divergent posteriorly behind pronotal disc; paranota large, completely reflexed, flat, resting spread out on pronotal disc, each with its outer margin coming in contact with median carina; hood very small, composed of four or five areolae on each side. Legs rather short; femora little swollen, indistinctly pubescent.

Elytra not much wider or longer than abdomen, with apices jointly rounded in repose; costal area narrow, uniseriate; subcostal area mostly biseriate, the areolae subequal in size to those in costal area; discoidal area tapering anteriorly, extending backwards scarcely beyond middle of elytra, widest slightly in front of apex, there widely acutely angulate; sutural area large, on same horizontal level as discoidal area. Boundry veins of discoidal area and vein separating costal and subcostal areas brownish or fuscous. Hind wings clear, functional.

HOLOTYPE ♂ and ALLOTYPE ♀, both macropterous, Dire Dawa, Ethiopia, Nov. 13, 1963, Edson J. Hambleton. PARATYPES: 2 specimens, collected with type.

This species is similar in size, form, and outward appearance to *D. abyssinica* (Drake) but readily separated from the latter by having shorter third antennal segment (18:27), shorter rostrum (15:11), and smaller areolae in elytra. The median carina of pronotum is uncovered for its entire length and both propleura are entirely black. We are indebted to Mr. R. J. Izzard for the comparison with the holotype of *D. abyssinica* in the British Museum.

Dictyla poecilla, n. sp.

Moderately large, grayish testaceous with some scattered spots on veinlets of paranota and elytra brownish to dark fuscous; head black with spines testaceous; bucculae testaceous, areolate, anterior ends meeting in front of labium. Antennae testaceous, pubescence sparse and inconspicuous. Legs testaceous with basal half of femora slightly embrowned. Rostrum brown, extending scarcely beyond mesosternum; sulcal laminae wide, testaceous, diverging backwards on mesosternum, widely separated and cordate on metasternum, closed behind. Pronotal disc reddish brown, covered by reflexed paranotum

on each side. Length 3.52 mm.; width (widest part of elytra) 1.30 mm.

Head very short, dorsal spines stout, basal pair appressed, other three porrect. Antenna slender, inconspicuously pubescent, measurements: segment I, 9; II, 7; III, 50; IV, 20. Antennal tubercles large, flat, plate-like, areolate. Ostiole and ostiolar canal not visible on either metapleuron.

Pronotum moderately convex, coarsely punctate, tricarinate; median carina percurrent, indistinctly areolate on pronotal disc; lateral carinae visible behind pronotal disc, covered on each side of median carina by the large, completely reflexed, flat, paranotum; lateral carinae visible and divergent on triangular process, concealed under outer vein of each paranotum, extending forward beyond middle of pronotal disc, there slightly convergent but not coming in contact with median carina; both sides of median carina and inner side of each lateral carina thickly-set with straight, pale, outwardly pointed, setal-like, bristly hairs. Legs moderately long, femora slightly swollen.

Elytra slowly roundly narrowed behind middle to apex, slightly overlapping each other within, apices jointly rounded; hypocostal lamina uniseriate; costal area narrow, mostly uniseriate, biseriate (5 or 6 areolae) opposite apex of discoidal area, areolae separated from one another by thick, dark, transverse veinlets; subcostal area wider, mostly three areolae deep; discoidal area large, wide at apex, anterior half narrow and tapering to a point at base, posterior part much wider, with outer boundary vein extending concavely into subcostal area, widest at base, there obtusely angulate; sutural area large, flat. Hind wings clear, functional.

HOLOTYPE ♂ and ALLOTYPE ♀, both macropterous, Dire Dawa, Ethiopia, on *Cordia rothii*. PARATYPES: 18 specimens, taken at the same time as type.

Separated from *D. abyssinica* (Drake) and *D. litotes*, n. sp., by its wider, elyptical form, partly biseriate costal area opposite apex of discoidal area, and apical two-fifths of outer boundary vein of latter area extending deeply concavely into subcostal area.

Haedus cirratus, n. sp.

Figure 2

Small, slender, blackish fuscous with paranota, costal areas of elytra, cephalic spines, bucculae, and hairy vestiture of dorsal surface whitish testaceous. Appendages testaceous. Body beneath blackish fuscous with pale vestiture. Length 2.30 mm., width (elytra) 0.65 mm.

Head very short, armed with five long dorsal spines, the median spine erect, others porrect; bucculae closed in front, areolate. Rostrum pale, extending to base of mesosternum in repose; sternal laminae of rostral sulcus brownish testaceous, uniseriate, closed be-

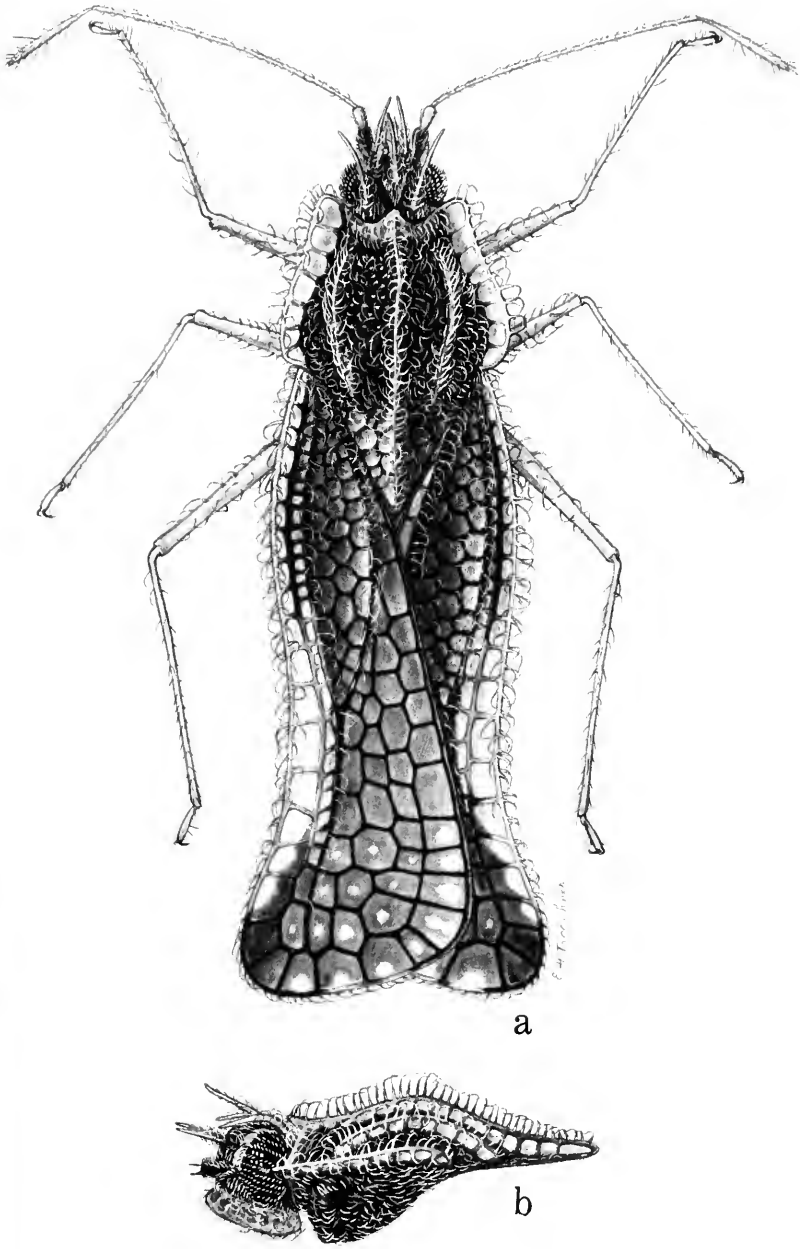

Fig. 2. *Haedus cirratus*, n.sp.

hind. Antenna long, slender, moderately clothed with pale, setal hairs, those on third segment recumbent, measurements: segment I, 8; II, 6; III, 50; IV, 22. Hairs on head, cephalic spines, paranota, and elytra fine, fairly abundant; those on outer margins of paranota and elytra longer, numerous, and closely-set with apices curled.

Pronotum moderately convex, punctate, clothed with numerous, reclining hairs, tricarinate; all carinae raised, lateral pair parallel, each composed of one row of quadrate areolae; paranota uniseriate, each composed of a single row of quadrate areolae larger than those in carinae; collar small, feebly raised at middle. Ostiole and ostiolar sulcus not visible on either metapleuron. Legs long, slender, sparsely clothed with pale setose hairs, those on tibiae slightly longer and pointed outward.

Elytra not much wider than abdomen, extending backwards beyond apex of abdomen, distinctly hollowed on outer margins, widest near apices, without discoidal turgescences; costal area composed of one row of clear, moderately large, quadrate areolae; subcostal area narrower than costal area, nearly vertical, also composed of one row of quadrate areolae; discoidal area elongate, extending backwards slightly beyond middle of elytron, narrowed at each end; sutural areas large, slightly overlapping each other in repose.

HOLOTYPE ♂ and ALLOTYPE ♀, both macropterous, on *Grewia mollis* A. Juss., Aug. 31, 1963, 60 km. west of Dire Dawa, on road to Addis Ababa, at. ca. 1100 m. PARATYPES: 50 specimens, taken on same plant with type. The holotype is illustrated.

The smaller size, downward curved tips of hairy clothing, and widely expanded apices of elytra separate this species from other members of the genus in Africa possessing uniseriate costal and subcostal areas and paranota.

Afrotingis, n. gen.

Small, distinctly lacy, paranota and elytra expanded outward, much wider and longer than body, side margins of paranota and elytra beset with sharp spines. Head very short, feebly produced in front of eyes; bucculae areolate, closed in front. Antennae short, slender, segments I and II very short, slightly swollen; III longest, very slender; IV slightly thickened, approximately half as long as III. Rostrum short, scarcely extending backward beyond prosternum; sternal sulcus of rostrum with laminae uniseriate.

Pronotum strongly convex, punctate, unicarinate, lateral carinae absent, hind margin triangularly produced backwards, areolate. Legs rather short, femora slightly swollen. Ostiole and ostiolar canal obsolete. Elytra without tumid elevations, divided into the usual areas, the discoidal area extending posteriorly beyond middle of elytron; hypocostal laminae uniseriate. Hind wings present, functional.

Type species: *Afrotingis eumenes*, n. sp.

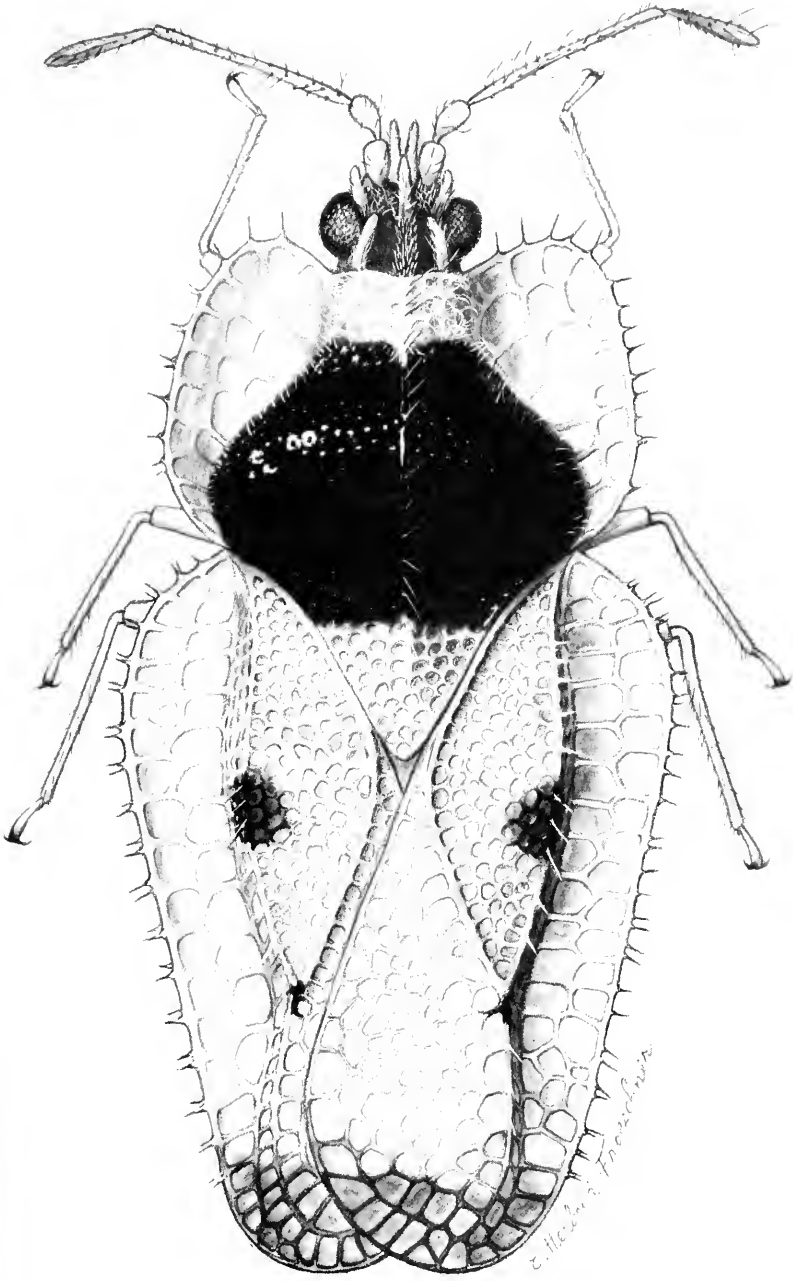

Fig. 3. *Afrotingis eumenes*, n.sp.

The unicarinate pronotum, long discoidal area, and widely expanded paranota and elytra distinguish this genus from other African genera. It belongs to the subfamily Tinginae, tribe Tingini, and is the smallest of the wide, finely lacy tingids in Africa.

Afrotingis eumenes, n. sp.

Figure 3

Small, oblong, clearly lacy, shining. Whitish testaceous with head, pronotal disc, and two large and two small spots on each elytron deep black; apical part of elytra brownish; areolae mostly hyaline. Antennae pale testaceous with terminal segment fuscous. Legs pale testaceous, with all tarsi dark. Body beneath black, shining. Length 1.82 mm., width 0.80 mm.

Head very short, hairy, armed above with five testaceous spines, each spine and median longitudinal part of head clothed with curly hair; bucculae testaceous, ends meeting in front, areolate. Antenna clothed with fairly long, stiff, setal hairs; measurements: segment I, 8; II, 6; III, 24; IV, 14. Rostrum short, brownish, terminating on forepart of mesosternum; rostral laminae uniseriate, present on all three sternal division, widely separated from each other, sometimes mostly black, then rather difficult to see.

Pronotum much swollen, finely punctate, unicarinate; median carina low, with a few upright, whitish spines; lateral carinae lacking; collar distinctly areolate, with two or three transverse rows of areolae, with a few slender upright spines at middle, there feebly narrowly extended backwards; paranotum wide, triseriate in front, biseriate opposite humeral angles, outside margins armed with long slender spines; hind process of pronotum triangular, areolate. Legs short, femora slightly swollen, each with scattered setal hairs.

Elytra divided into the usual areas, without tumid elevations, slightly whitish, transparent, armed along outer margins with long, slender spines, each situated on a thickened base; boundary veins of discoidal area armed with slender, upended spines with thick bases; costal area wide, composed of two full rows of fairly large areolae; subcostal area mostly biseriate, sloping downward; discoidal area large, about three-fourths as long as elytron, widest near middle, there six or seven areolae deep, outer boundary vein convex within, base and apex narrowed, each acutely angulate; sutural area large, on same level as discoidal area. Hind wings present.

HOLOTYPE ♂ and ALLOTYPE ♀, both macropterous, on *Grewia mollis*, A. Juss., 60 km. west of Dire Dawa, along road to Addis Ababa, elev. 1100 m., Aug. 30, 1963. PARATYPES: 4 specimens, taken on the same tree with types. The holotype is illustrated.

KANGAROO RAT BURROWS AT THE NEVADA TEST SITE[1]

Arthur O. Anderson[2] and Dorald M. Allred[3]

The chisel-toothed kangaroo rat, *Dipodomys microps occidentalis* Hall and Dale, inhabits most of the major plant communities at the Nevada nuclear test site. Because it is abundant and widely distributed at the test site it has been studied considerably with respect to its reaction to the effects of nuclear weapons testing.

This study, as part of a broad ecological study described in detail by Allred, Beck and Jorgensen (1963), was made to determine the nature of burrows made by this animal in different soil types and plant communities. Such information is important in evaluating the radiation dosage a rat may receive while in its burrow, and the effects of soil compaction from over-pressure of a nuclear detonation.

Procedure

Burrows were excavated in five plant communities during the spring and summer of 1961 as follows: ten burrows in *Salsola kali* and five each in *Atriplex confertifolia-Kochia americana*, *Lycium pallidum*, *Grayia spinosa-Lycium andersoni*, and *Coleogyne ramosissima*.

To locate occupied burrows for study, rats were live-trapped, released and their escape pattern noted. After release each rat quickly sought refuge in a burrow. Several minutes were spent observing the opening which the rat entered as well as the immediate vicinity to determine whether it emerged and entered another one. If no such movement were noted it was assumed that this was the principle burrow of the rat, and the burrow was marked for later excavation and study.

White (1962) used a grout mixture to make concrete molds of animal burrows, but the disadvantages of his system were prohibitive for its use for our studies. Consequently, a shovel, pick and small garden trowel were used to excavate the burrows. Care was taken to leave the sides and floor of each burrow intact.

Burrows were mapped as they were excavated. Two seven-foot pipes, joined to form a right angle, were marked at one-foot intervals. The horizontal pattern of each burrow was thus recorded on grid paper. Additional measurements were taken where necessary to insure greater accuracy. Measurements of depth were made at one-foot intervals. Average depth was determined from measurements taken (1) where the tunnels branched, (2) where the passages continued for a considerable distance at the same level, and (3) at the lowest point of the burrow. Although side passages and pockets were measured and mapped, those within three inches of the main

1. Report No. C00-1355-3 Field work completed under AEC Contract AT(11-1)-786.
2. Mapusaga High School, Samoa.
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passage were excluded from the depth profiles to facilitate clear diagrams.

Five to ten penetrometer measurements were taken to determine comparative rockniess of the soil and depth of the hardpan at each burrow site.

Results

Vegetative complexes of the communities were discussed by Allred, Beck and Jorgensen (1963). Johnson and Hibbard (1957) designated the geological formations and general soil types for the test site. Following are brief resumes of our study sites and the results of excavation and burrow examination (Table 1).

Atriplex-Kochia Habitat (Plate I). This site is located near the lowest part of the valley north of the playa in Yucca Flat. The soil is primarily hard clay several inches deep with two or three inches of loose sand around the base of the plants. Below the clay is a shallow layer of sandy clay, under which is a hardpan. The average penetrometer reading was 7.24 inches.

Table 1. Burrow depths, openings and number of dead-end side burrows.

Habitat	Depth in inches		No. openings		No. side-burrows	
	Greatest	Average	Greatest	Average	Range	Total in all burrows
Atriplex-Kochia	12	9.2	3	1.8	2-8	18
Coleogyne	24	15.7	3	2.2	3-5	22
Grayia-Lycium	24	15.3	6	3.2	6-18	56
Lycium	24	11.5	5	2.6	3-9	25
Salsola	24	12.8	4	2.7	2-9	26*

*Only five burrows used for comparison.

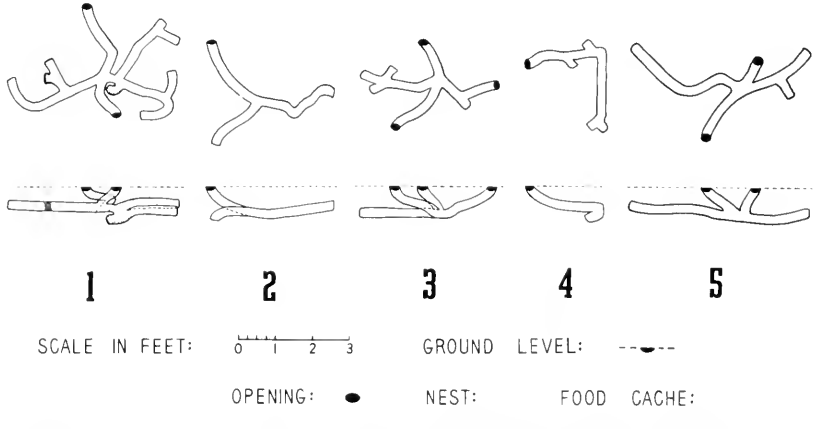

Plate I. Patterns of five burrows in the Atriplex-Kochia habitat. Upper figures: horizontal patterns; lower figures: corresponding vertical patterns.

The burrows were predominantly in the sandy clay soil immediately under the layer of clay. No burrow penetrated the hardpan. Openings were usually in the open spaces between plants. The burrow patterns were simple with relatively few side passageways. A nest constructed of plant materials was found in one burrow at a depth of one foot. A food cache containing hulls of seeds was located near the nest. All burrows had several camel crickets in them, and a harvestman and a centipede were seen near the nest of one burrow.

Coleogyne Habitat (Plate II). This site is located on the upper slope of the bajada in northeastern Yucca Flat. The soil is somewhat sandy with some clay and rocks of various sizes. A hardpan is usually present at a depth of about one foot. The average penetrometer reading was 9.13 inches.

The burrows in this area had no side passageways used as food caches. Evidence of one food cache in the main passageway consisted of small scatterings of seeds of annual plants. Three burrows each had one nest at a depth of 17, 18 and 21 inches, respectively.

Grayia-Lycium Habitat (Plate III). This study area is on the lower gentle slope of the bajada of northwestern Yucca Flat. The soil is sandy with some clay, but somewhat compact. Small pebbles are present, and a few rocks up to several inches in diameter are

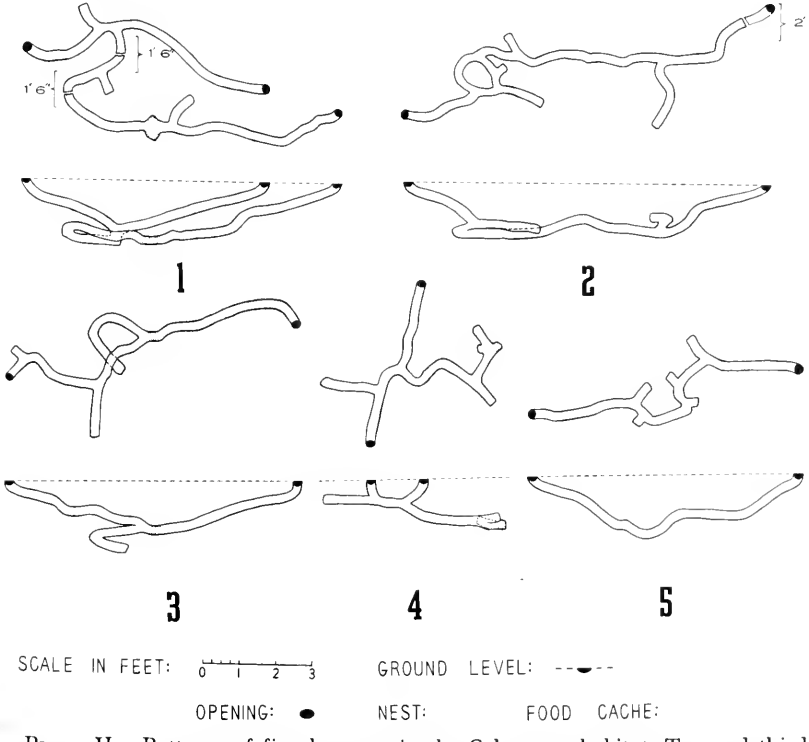

Plate II. Patterns of five burrows in the Coleogyne habitat. Top and third rows: horizontal patterns; second and fourth rows: corresponding vertical patterns.

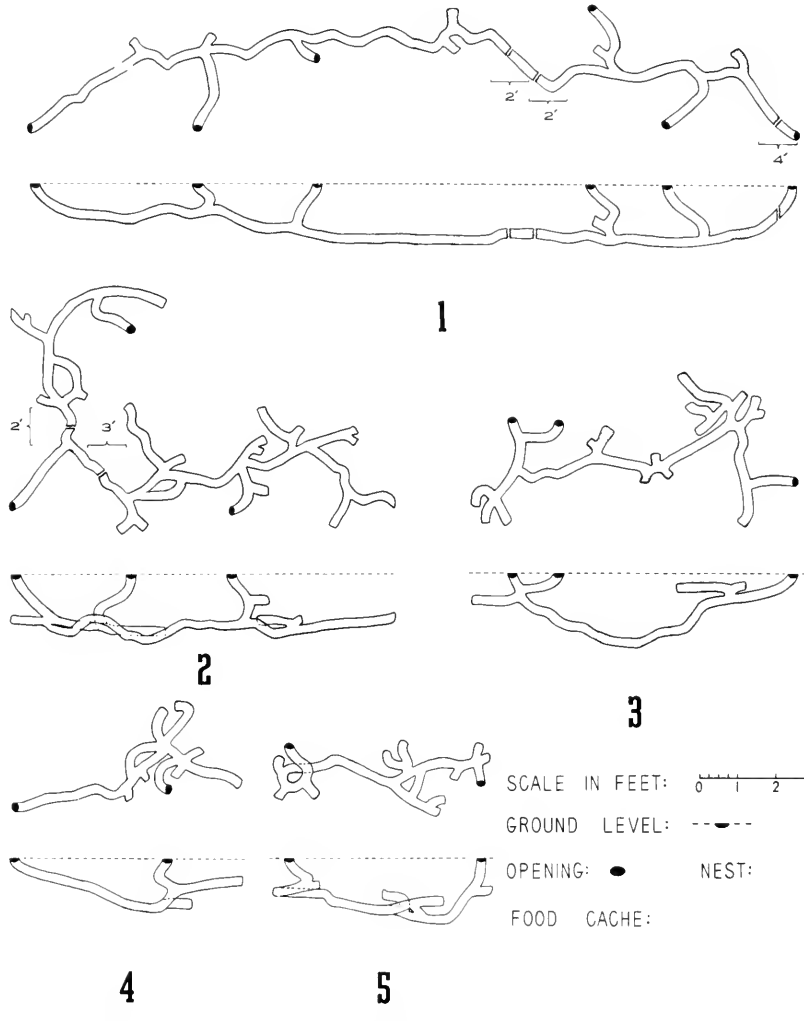

PLATE III. Patterns of five burrows in the Grayia-Lycium habitat. Top, third and fifth rows: horizontal patterns; other rows: corresponding vertical patterns.

common on and near the surface. The average penetrometer reading was 14.49 inchs.

Most of the burrow openings were in the open spaces between the plants. Two burrows contained nests, one burrow having two. These were at a depth of 22, 19 and 15 inches, respectively. Food caches of seeds, leaves and a few stems were found next to the nests. In one burrow lacking a nest a food cache of freshly cut green grass and seeds of a composite were found.

Lycium Habitat (Plate IV). This site is in the lowest part of the valley southwest of the playa in Frenchman Flat. The surface soil is sandy with some clay and small rocks. Generally the soil is loose for a considerable depth. The average penetrometer reading was 20.32 inches.

Burrow openings in this area were usually concealed by the foliage of the plants. Even though there were frequently several openings, the one most commonly used was usually well concealed near the center of the area covered by the plant. No food caches or nests were found in these burrows.

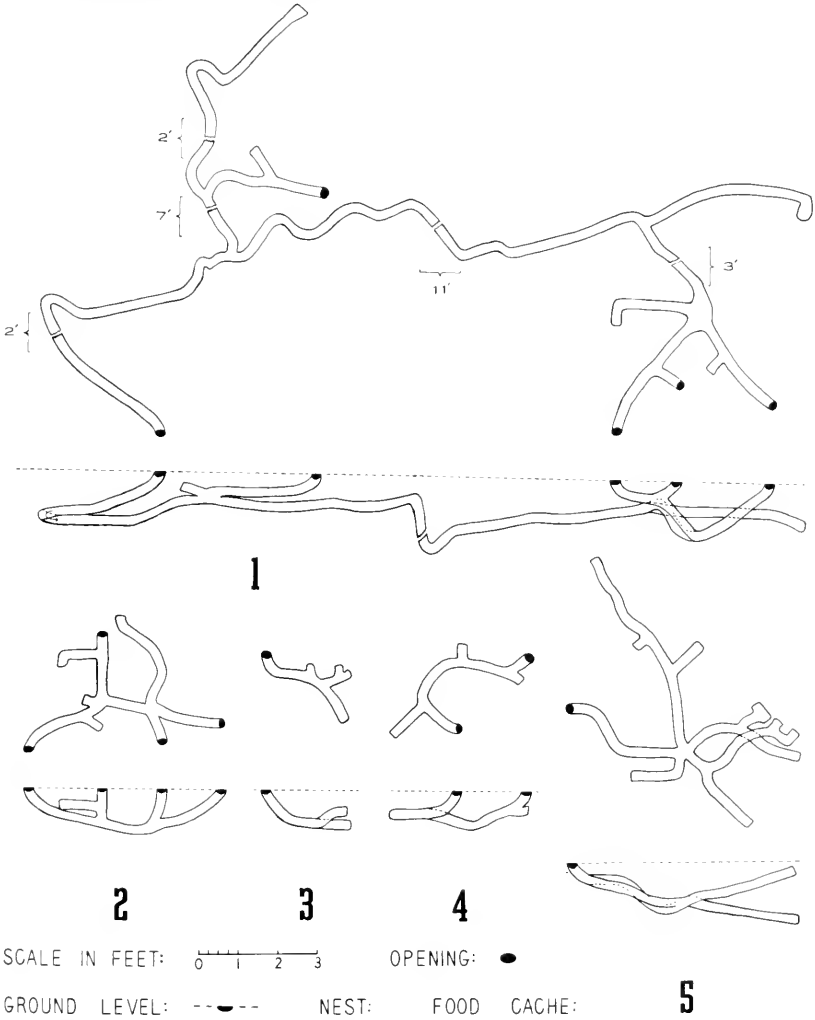

Plate IV. Patterns of five burrows in the Lycium habitat. Top and third rows: horizontal patterns; other rows: corresponding vertical patterns.

Salsola Habitat (Plate V). This site is situated in a Grayia-Lycium area where nuclear detonations have destroyed the native vegetation and *Salsoli kali* has become established. The soil is similar

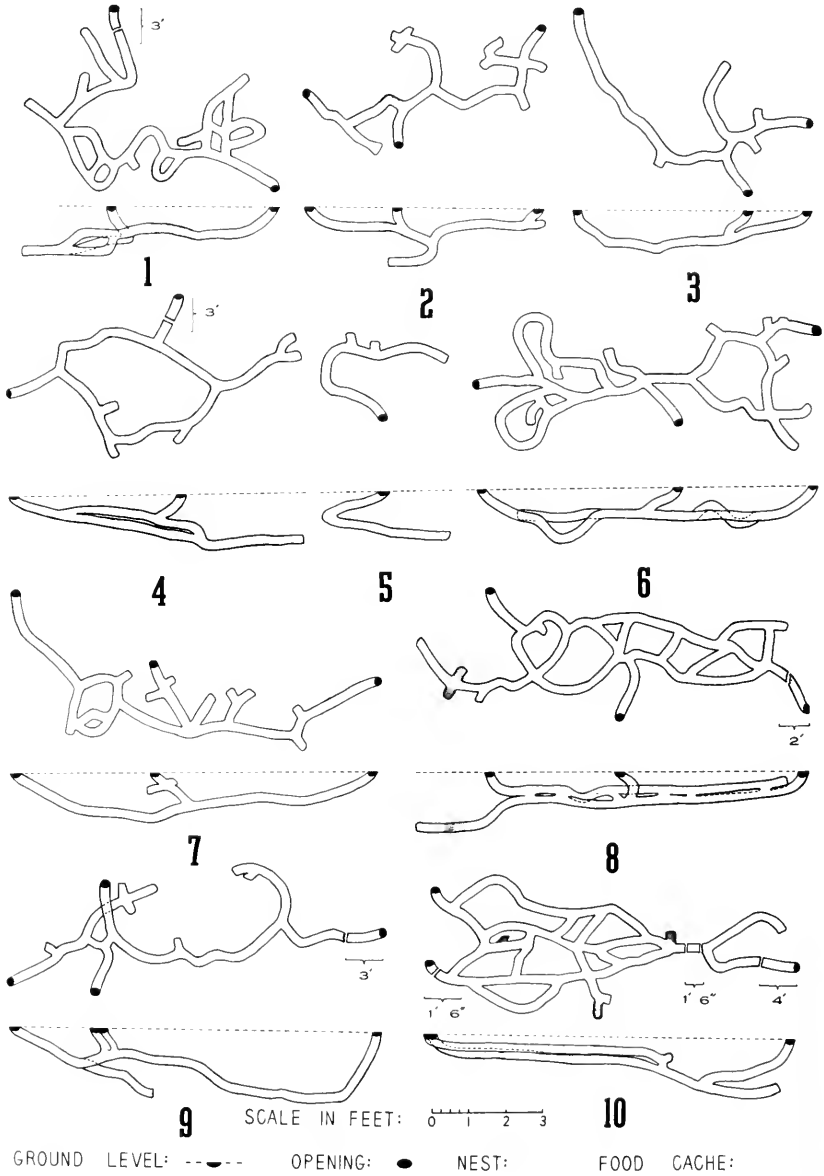

Plate V. Patterns of ten burrows in the Salsola habitat. Top, third, fifth and seventh rows: horizontal patterns; other rows: corresponding vertical patterns.

to that at the Grayia-Lycium site except that it is not as compacted. Rocks two inches or more in diameter are common, especially on the surface. The presence of more surface rocks in this area may be partly due to the effects of nuclear detonations. The average penetrometer reading was 15.75 inches.

Some of the burrows in this area were the most complex of any excavated. Many openings were plugged with soil three or four inches below ground surface. Only one nest was found, at a depth of 20 inches. Near the nest was a food cache principally of seeds of *Salsola*. Food caches found in four other burrows consisted principally of *Salsola* seeds, with small amounts of stems.

Discussion

The most complex burrows occurred in the Grayia-Lycium and Salsola habitats. Inasmuch as the predominent vegetation of the Salsola habitat originally was *Grayia* and *Lycium* before nuclear disturbance, it is assumed that the type of soil in the Grayia-Lycium community is more conducive to burrowing activities than the hard clay of the Atriplex-Kochia and rocky soil of the Coleogyne areas. This is substantiated by the larger number of side burrows present in the Grayia-Lycium—twice the number of any other habitat. Burrows in the hard clay of the Atriplex-Kochia habitat were shortest and least complex of all. Although the longest burrow excavated was in the Lycium area, this was an exception to the pattern of others in the same habitat. Soil texture likely influences the depth to which a rat will burrow, but even in the loose soils burrows did not exceed two feet. Tappe (1941) maintained that depth of burrow is determined by soil conditions. In 31 burrows of *D. heermanni* excavated, he found only one which exceeded 20 inches in depth. Hawbecker (1940) found *D. venustus* burrows 20 inches in depth, Grinnell (1932) found the greatest depth for *D. ingens* to be about 18 inches, and Culbertson (1946) and Fitch (1948) found the greatest depths for *D. nitratoides* and *D. heermanni*, respectively, to be 24 inches. Huey (1942, 1951) stated that *D. merriami* avoids rocky situations and cannot burrow into very hard soil. Hardy (1945) indicated that shallow loose soil above a hardpan was satisfactory for burrowing.

The number of burrow openings was greatest in the Grayia-Lycium area. Considering the variable numbers of openings in all habitats, two and three per burrow occurred with greatest and about equal frequency. Grinnell (1932) found 2-hole burrows most common for *D. ingens*, whereas Tappe (1941) found three or four the usual number for *D. heermanni*.

Nearly all the short, side passageways used for food storage were about two inches above the level of the main passageway floor. Other short, deadend passageways ended two or three inches above the floor level of the main passageway, although occasionally they were lower.

Seven of 30 burrows contained nests and eight had food caches. No reason for this low incidence is known. Fitch (1948) found old

nests in only 11 of 150 burrows of *D. nitratoides*. Tappe (1941) found nine nests in 17 main burrows of *D. heermanni*. Hawbecker (1940) found that *D. venustus* had several supplementary burrows which always lacked nests and food caches. Apparently *D. microps* does not commonly build nests or perhaps dismantles them when no longer needed or the rat moves to another burrow. However, it is possible that many of our burrows were supplemental burrows.

The low incidence of food caches seems more easily explained. Food storage likely is correlated with season and food availability. Perhaps a rat is active above ground on succeeding nights only until a small store of food has been accumulated. Further activity above ground may then be suspended until the stored food is exhausted. Fitch (1948) maintained that storing of food in the burrows of *D. heermanni* is usually on a small scale to make available a constant supply during the majority of the hours that the animal is underground. Although Culbertson (1946) did not specifically study food storage habits of *D. nitratoides*, he did observe that food was occasionally stored in small pits in the burrow. Grinnell (1932) found no food caches in the burrows of *D. ingens*, although he found seed shells and hulls to be common. Tappe (1941) found food caches in many of the burrows of *D. heermanni*. Shaw (1934) found many underground food caches of considerable amounts, up to eight quarts each, in the burrows of *D. ingens*. Hardy (1945) found large food caches in the burrows of *D. microps* in southern Utah in September. Through our observation in the field, some evidence suggests that rats store seeds in small caches in shallow graves outside their burrows. Once a food source is located this likely facilitates emptying their cheek pouches of collected food without having to return relatively great distances to their burrows. Reynolds (1950, 1958) indicated that *D. merriami* stores excess seeds in surface caches. Such food is transported from 2 to 105 feet (average about 47 feet) before being cached. In fall, winter and spring many of the surface caches are opened by the rats. Shaw (1934) found surface food caches very numerous near the burrows of *D. ingens*. These caches were frequently transferred to the den. Hawbecker (1940) also found surface caches to be common for *D. venustus*.

Although it is assumed that the behavior of *D. microps* is similar to that of other species, further studies of their food and burrowing habits are needed.

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THE RECENT NATURALIZATION OF SIBERIAN ELM (*ULMUS PUMILA* L.) IN UTAH

Earl M. Christensen[1]

ABSTRACT: The history of naturalization of Siberian Elm (*Ulmus pumila* L.) in Utah is presented. Establishment of the species in nature occurred quickly after its introduction into Utah, and it has become a conspicuous part of the vegetation in lowland areas in Utah valleys. The earliest documented date of establishment in nature in Utah is 1935. The species was not cultivated in Utah and adjacent states prior to 1920. It was recommended for use in the western United States during the 1920's, and it was extensively planted during the 1930's and 1940's. The naturalization of Siberian Elm is similar to the earlier naturalization in Utah of tamarix (*Tamarix pentandra* Pall.) and Russian olive (*Elaeagnus angustifolia* L.).

INTRODUCTION

During the last two decades Siberian Elm, *Ulmus pumila* L., has become a conspicuous and abundant plant in wildland areas in Utah: pastures, streamsides, canyon bottoms, and vacant urban lots. Because of the evident rapidity of naturalization of this species an attempt is made in this paper to document its spread into nature and to determine the rate of naturalization. The naturalization of Siberian Elm is particularly interesting because it parallels the earlier introduction and naturalization of tamarix (Christensen, 1962) and Russian olive (Christensen, 1963) in the same area and often in the same habitats.

Siberian elm is a rapidly growing, medium-sized tree that is native from Turkestan to eastern Siberia and northern China (Little, 1961). It was introduced into the United States (Chico, Calif.) in 1908 (Dorset, 1917), and proved to be adapted as an ornamental tree (Bureau of Plant Industry, 1918). It has been recommended for use in the western United States (Mulford, 1926, 1928; Thomas, 1927; Metcalf, 1928; Dougall, 1942; Wilson, 1944; Little, 1949, 1961; U. S. Dept. Agr., 1949), but recently it has been considered undesirable in Utah for street plantings (Utah Shade Tree Comm., 1960; Provo City Shade Tree Comm., 1960). Gill (1949) described the good and bad features of the species. Data on reproduction of the Siberian elm was presented by Metcalf (1928), the Forest Service (1948), and Vines (1960). The naturalization of Siberian elm from Kansas to Minnesota was noted by Fernald (1950), and Steyermark (1963) observed that the species has occasionally escaped cultivation in Missouri.

Siberian elm has often been referred to as Chinese elm or

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Chinese dry-land elm. In Utah, Chinese elm is often used currently in reference to *Ulmus pumila*.

Cultivation of Siberian Elm in Utah

Siberian elms were planted in northern Utah near Providence about 1922 (Metcalf, 1928), but a survey of historical sources leads to the conclusion that Siberian elm was not planted in Utah prior to about 1920 (Paul, 1916; Mulford, 1920; Rydberg, 1922; Cannon, 1924, 1934; Tidestrom, 1925; Dougall, 1942; Reimschüssel, 1951).

During the 1930's and 1940's Siberian elm was planted commonly in Utah and the adjacent region, and by the late 1940's it was abundant in cities of the area (Preston, 1940; Dougall, 1942; Cottam, 1943; Reimschüssel, 1947, 1951, 1958; Gill, 1949; Little, 1949).

Naturalization of Siberian Elm in Utah

The establishment of Siberian elm in wildland in Utah began shortly after its use as an ornamental, as early as 1935. Siberian elm was evidently uncommon in nature in Utah prior to 1940 because it was not included in any regional manual published before 1948 (Rydberg, 1922; Tidestrom, 1925; Garrett, 1936; Coulter and Nelson, 1937; Graham, 1937; Holmgren, 1948). The first published record of Siberian elm in nature in Utah was made by Nelson (1954).

Evidence about the date of naturalization of Siberian elm can be obtained from tree ring counts of older trees in wildland. Some large specimens of Siberian elm grow near Utah Lake west of Orem City. Two of these were studied. Increment borings from these trees indicate that they were established in 1935 and 1945. The trees have grown rapidly. The rates of growth in diameter were determined to be 0.8 in. and 0.9 in. per year and the terminal growth to be 1.6 ft. and 1.8 ft. per year for the older and younger trees, respectively. The 1935 date appears to be the earliest record of establishment of Siberian elm in nature in Utah. Certainly Siberian elm was not present in the vicinity of Utah Lake a decade earlier. Cottam (1926) did not include it in his comprehensive ecological study of the area.

Discussion

Three old world woody species have rapidly invaded the lowland areas of the valleys of Utah in this century, and the vegetation of these areas is undergoing rapid change as these species are increasing in abundance. Tamarix (*Tamarix pentandra* Pall.) became established in nature prior to 1925 (Christensen, 1962), and Russian olive (*Elaeagnus angustifolia* L.) became established about 1924 (Christensen, 1963). These species were followed by Siberian elm reported on in this paper which became established about 1935. In contrast to the lowland areas in Utah, establishment of woody exotics (*Robinia pseudoacacia* L., *Ailanthus altissima* (Mill.) Swingle, *Prunus* spp., *Malus* spp.) in the more elevated portions of Utah has resulted in very minor change of the vegetation of those

areas. Continued ecological study should be carried on too explain the striking patterns of naturalization exhibited by tamarix, Russian olive, and Siberian elm in Utah and the vegetational changes resulting therefrom.

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ON SOME NEW SPECIES OF NYCTERIBIIDAE (DIPTERA: PUPIPARA)

O. Theodor[1] and B. V. Peterson[2]

A small collection of Nycteribiidae received from Dr. W. L. Jellison, Rocky Mountain Laboratory, Hamilton, Montana, and Dr. R. Wenzel, Chicago Natural History Museum, Chicago, Illinois, contained three new species which are described below, and several additional distribution records.

Genus *Basilia* Miranda Ribeiro
Subgenus *Basilia* s. str.
Basilia mimoni n. sp.

Length 2.2 - 2.5 mm. Color yellowish brown.

Head with 4 setae at the anterior dorsal margin and 1-2 minute hairs on the vertex. Gena bare or with a few minute hairs. Palpus slender, wider at the base. Labella of labium slightly shorter than the theca.

Thorax about as long as wide. Median sternal suture distinct, the oblique sutures forming an angle of about 85°. The hairs on the sternal plate are longer posteriorly; the posterior margin with a row of short setae and 2 longer setae in each half. Mesonotum parallel-sided, not very wide, posterior plate without a process. Lateral plates of the notopleural sutures with 10-12 notopleural setae which stand more closely posteriorly. Mesopleural suture narrow, distinct. Thoracic ctenidium with 18-20 narrow, pointed spines. Legs long and slender. Tibiae 5-6 times longer than wide, with 3 rows of setae in the middle of the ventral surface; the distal row consists of longer setae which reach the end of the tibia or beyond; the setae of the other two rows are short. The ends of the tibiae are long and tapering (Fig. 1).

Abdomen Male. Tergite I with a straight posterior margin with a row of short setae. Tergites II - IV with a single marginal row of moderately long setae of uniform length which stand more closely together laterally; a few spines between the setae in the middle of the row. Tergite II with 1 - 2 rows of short setae on the surface, 4 - 8 such setae on tergite III in an irregular double row, and only 2 - 4 short setae on tergite IV. Tergite V similar, but 2 - 4 setae in the middle of the marginal row are longer and there are about 8 short vertical setae between these long setae; surface bare. Tergite VI similar, but much less wide, with 4 long setae in the middle of the marginal row. Anal segment conical, with 3 - 4 long setae posteriorly, 2 short setae in the middle of the dorsal surface and a few short setae in the posterior half of the surface and at the sides.

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Sternite I + II with a ctenidium of 42 - 44 spines, shorter than in the female. Sternites III and IV with uniform marginal rows of moderately long setae, and 4 long vertical setae in the marginal row of sternite IV. The surface of sternite III with 2 - 3 rows of short setae; only one row, which is interrupted in the middle, on the surface of sternite IV. Sternite V similar in shape, rectangular, with a rounded bulge in the middle of the posterior margin which bears a group of 14 - 16 spines in two rows; the 4 median spines of the posterior row are longer than the others; long horizontal setae stand at the margin lateral to the group of spines and there is a preapical row of long and short setae; surface otherwise bare (Fig. 2).

Genitalia (Figs. 2-3). Claspers thin, tapering, black apically; a long seta dorsally near the base and 3 shorter setae in the basal half. Basal arc large, rounded, with a long anterior process. Phallobase strongly concave dorsally, with 2 setae near the base. Aedeagus broad, with a rounded or truncate end and a few teeth dorsally on the basal part. Paramere with a pointed apex, ventral margin rounded in the distal half; a few minute hairs on the sides.

Abdomen Female (Figs. 4-5). Tergite I trapezoidal, with a row of setae at the posterior margin and a gap in the middle; with 2 or 3 median setae next to the gap which are longer; a few small spines on the surface. Tergal plate II rather short, divided in the middle, with 1 - 2 long, apical setae on the posterior processes, and 4 - 6 shorter setae at the posterior lateral margins; some short setae along the median division line and some in the anterior and lateral part of each half. A slightly curved pigmented stripe runs from the posterior processes to the shoulders; there are no setae on these stripes. Tergal plate III absent. Pleurae and lateral parts of the dorsum covered with short setae, leaving a bare median stripe from the posterior processes of tergal plate II to the anal segment. A row of slightly longer and stronger setae along the posterior margin of the anterior bulge of the abdomen. Anal segment rectangular, much wider than long, bare dorsally and with a long and 1 - 2 shorter setae posteriorly and a few short setae laterally. Postspiracular sclerite narrow, curved, with 3 longer setae at the end and a few minute spines along the posterior margin. Sternite I + II long, with a ctenidium of about 50 long, pointed spines and short setae in the posterior part of the surface and laterally. Sternite III long, with a uniform row of moderately long setae posteriorly and about 6 rows of short setae on the surface which are shorter posteriorly; a few long vertical setae in the last row of the surface. Sternite IV with a similar marginal row and only one row of short setae on the surface which is double laterally. Sternite V laterally with 2 narrow sclerites, each with a straight posterior and a rounded anterior margin; two long, vertical setae at the lateral corners of each sclerite, and with 4 - 5 horizontal setae towards the middle and 2 - 3 shorter vertical setae near the margin. Sternite VI undivided, with strongly convex anterior and slightly convex posterior margin, with 2 long vertical setae at the posterior lateral corners and shorter

horizontal setae along the posterior margin; 1 or 2 rows of short, vertical setae on the surface. Sternite VII rounded posteriorly, more strongly sclerotized laterally, with several moderately long setae laterally and posteriorly. Anal sclerite small, drop-shaped, with two setae; not connected with the genital plate. Adanal plates triangular, with 2 - 3 setae at the distal end; near their proximal ends are two small, sclerotized areas with a scaly surface. Genital plate with 4 setae and a triangular field of small spines anterior to it (Fig. 6).

Basilia mimoni belongs to the *ferruginea* group of the subgenus which has posterior processes on tergal plate II, absence of tergal plate III, and sternite VI undivided. Among the species of the group it resembles *B. rondanii* and *B. silvae*. It differs from *B. rondanii* in the female in having only 4 setae on the anterior margin of the head, in the form of the tibiae, in the absence of a median process on the posterior plate of the mesonotum and in the chaetotaxy of the abdomen. It has only 1 - 2 setae on the posterior processes of tergal plate II, while *B. rondanii* has 4 - 6 such setae. In the male it differs in the arrangement of the spines on sternite V and in the genitalia.

B. mimoni differs from *B. silvae* in having 10 - 12 notopleural setae, in the female in having longer setae at the posterior margin of tergite I, a much shorter tergal plate II with only 1 - 2 setae on the posterior processes, shorter setae on the pleurae and a different anal segment. There are 14 - 16 spines in a compact group on sternite V in the male, while there are 20 such spines in *B. silvae*, and the genitalia are different.

B. mimoni is also closely related to *B. tiptoni*, a species recently described from Panama, but differs from it in the absence of a digitiform process on the posterior plate of the mesonotum, in the absence of posterior processes on tergite I of the female, and in the much shorter tergal plate II with only 1 - 2 setae on the posterior processes (*B. tiptoni* has 4 such setae), the shorter setae on the pleurae and a different form of the anal segment. In the male it differs in having 14 - 16 spines on sternite V, some of which are longer than the others, while there are only 11 such setae of about equal length in *B. tiptoni*.

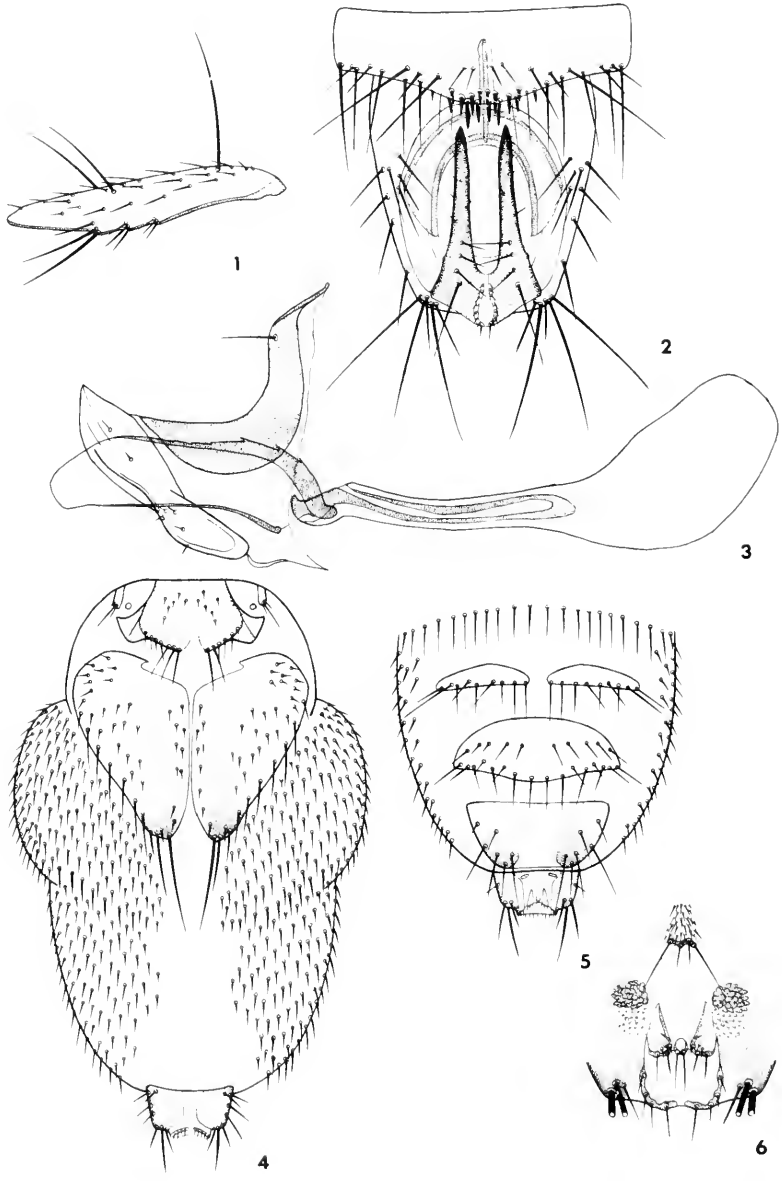
Holotype female, 2 male and 5 female paratypes in the Chicago Natural History Museum. One male and one female paratypes in the Department of Parasitology, Hebrew University, Jerusalem. Host: *Mimon crenulatum*, Rio Yavary, Department Loreto, Peru, October 2, 1957. Coll. Celestino Kalinowski. Zool. Peru Exped. 1956-57.

Basilia jellisoni n. sp.

FEMALE. Length 2.2. mm. color yellowish, possibly bleached.

HEAD with 6 setae at the anterior dorsal margin. Labella of the labium half the length of the theca.

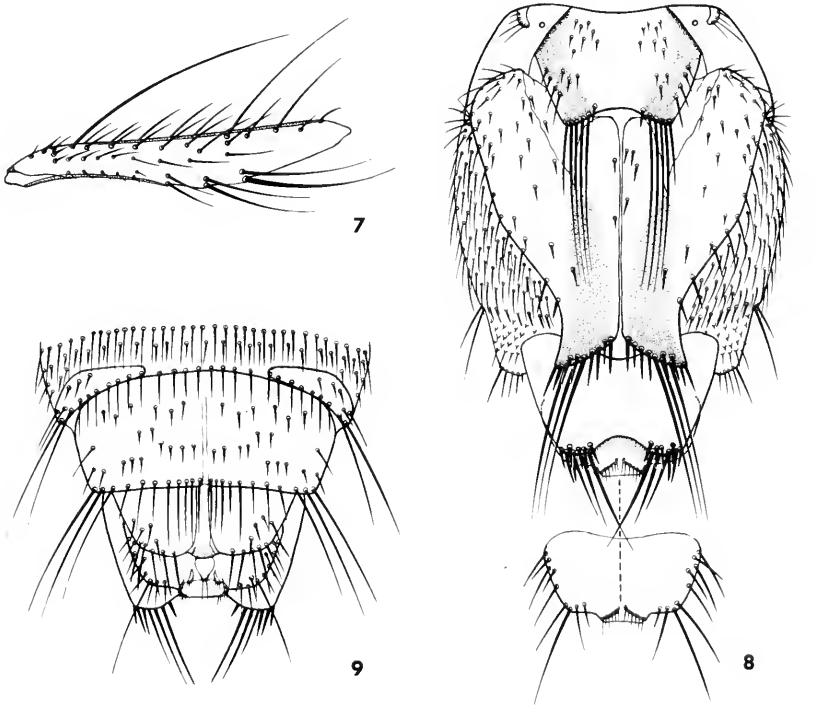
THORAX wider than long; length to width = 3 : 4. Median sternal suture widened in the middle; oblique sutures forming an angle of about 90°. Posterior margin with a row of short setae and 1 - 2



Figs. 1-6, *Basilia mimoni* n. sp. 1, mid tibia. Figs. 2-3, male. 2, sternite V and genital area; 3, genitalia. Figs. 4-6, female. 4, abdomen, dorsal; 5, abdomen, posterior part, ventral; 6, anal and genital plates.

longer setae laterally. Mesonotum wide, posterior plate without a process. Lateral plate of the notopleural suture wide, with 10 notopleural setae. Tibiae very long, slender; mid tibia 6 times longer than wide, with 3 rows of setae in the middle of the ventral margin, those of the distal row long, reaching beyond the tip of the tibia (Fig. 7).

Abdomen (Figs. 8-9). Tergite I hexagonal, with two groups of 4 very long and one shorter setae at the posterior margin and a wide gap between the two groups; several short setae laterally at the posterior margin; a pigmented stripe along the lateral margins and a few short setae on the surface. Tergal plate II long, heart-shaped, with broad, truncate posterior processes which bear 3 long setae, an irregular, double row of 8 - 10 very long spines, and with 4 - 6 shorter setae at the posterior lateral margins; some short, thick setae on the surface, some along the median division line, the others lateral to a broad, pigmented stripe which runs from the posterior processes into the middle of each half. Tergal plate III very large, trapezoidal, bare on the surface and with a group of 2 - 3 long setae and about 6 long spines at the posterior lateral corners and a concave gap between them; both setae and spines shorter than on tergal plate II. Anal segment, in dorsal view, nearly completely covered by



Figs. 7-9, *Basilia jellisoni* n. sp., female. 7, mid tibia; 8, abdomen and anal segment, dorsal; 9, abdomen, posterior part, ventral.

tergal plate III; it is wider than long, bare on the surface and has 1 - 2 longer setae posteriorly and shorter setae laterally. Pleurae with numerous setae of moderate length and very short spines posteriorly. Postspiracular sclerite narrow, curved, with 3 longer setae at the end and very short spines along the posterior margin. Sternite I + II very wide, with a ctenidium of 64 long, pointed spines. Sternites III and IV with longer setae at the posterior margin, sternite III covered with short setae. Sternite IV with a similar marginal row and apparently no setae on the surface. This is difficult to make out, since the specimen is contracted. Sternite V with 2 widely separated narrow sclerites with 2 long setae at the lateral corners, shorter setae towards the middle and a few setae on the surface. Sternite VI large, broad, rectangular, with straight posterior margin, long setae at the posterior lateral corners and shorter setae which stand more closely in the middle at the posterior margin; several rows of short setae on the surface. Sternite VII much narrower, rounded posteriorly, incompletely divided in the middle and with a small, rounded process in the middle of the posterior margin; long setae at the sides of the posterior margin and 4 - 5 shorter setae on the surface in the posterior lateral part. Anal sclerite with 2 setae at the apex, widening basally. Adanal plates triangular, with a few short setae at the end. Genital plate with 4 setae.

Male unknown.

The single specimen available (M-395) was collected from *Myotis yumanensis* taken at Frenchtown, Missoula Co., Montana, July 7, 1958, by F. Bell.

These data are uncertain and thus provisional, but it seems desirable, however, to have the specimen described as it shows a number of unusual characters. Female holotype in the Chicago Natural History Museum.

Only four American species of *Basilia* possess a 3rd tergal plate. Of these, *B. antrozoi* and *B. pizonychus* differ from *B. jellisoni* in the shape of tergal plate II, in the divided tergal plate III and other characters. *Basilia anomala* differs in the shape of the posterior processes of tergal plate II and the spines on them, the different shape of tergal plate III, the setae on the pleurae and the different shape of sternites V and VI. *Basilia forcipata* differs in the much shorter tergal plate II, the presence of setae on the surface of tergal plate III, the much longer anal segment and other characters.

Basilia magnoculus Schuurmans-Stekhoven, 1942

Zeitschr. Parasitenk. 12:533

The species belongs to the *nattereri* group of the subgenus and has reduced, weakly pigmented eyes, consisting usually of a single ocellus, sometimes of two. It was described from Java from *Myotis horsfieldi* and *Scotophilus temmincki*, and it is also known from Amboina.

The specimen recorded here (A.P. 23473) is a female from *Myotis horsfieldi* collected by W. L. Jellison in Borneo, November, 1941.

Basilia pudibunda Schuurmans-Stekhoven, 1941
Bull. Hist. Nat. Belg. 17:1

This species also belongs to the *nattereri* group and is easily recognized by the characteristic structure of tergal plate II which is divided into four longitudinal parts.

The species was described from Boentok in Borneo from a vespertilionid bat. It has also been found in Thailand on *Myotis horsfieldi*, in Indochina on *Cynopterus brachyotis angulatus*, and in East Sumatra.

The specimen recorded here (A.P.23512) is a female from *Myotis horsfieldi* collected in Singapore by W. L. Jellison in November, 1941.

Subgenus *Tripselia* Scott, 1917
Basilia (*Tripselia*) *triseriata* Theodor

The species has been described from a single male from Selangor, Malaya, from *Nyctalus stenopterus* in a revision of the family which is now in press.[3] The holotype is in the Chicago Natural History Museum.

The specimen recorded here (A.P.23475) is also a male, from Malaya, from *Nyctalus stenopterus*, collected by W. L. Jellison in November, 1941.

Genus *Penicillidia* Kolenati, 1863
Penicillidia godivae n. sp.

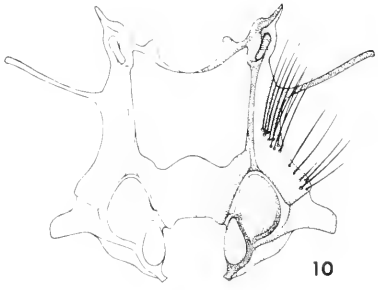
MALE. Length 4 mm. Color light brown, probably bleached.

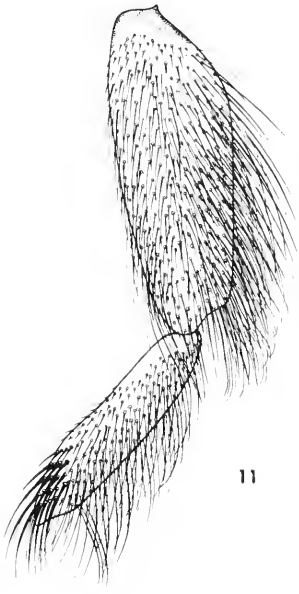
HEAD. The whole dorsal surface densely covered with long, light brown setae. Eyes small, little protruding above the surface. Palpus wide, ventral surface covered with numerous setae, the terminal seta not differentiated. Labella of labium about as long as the theca.

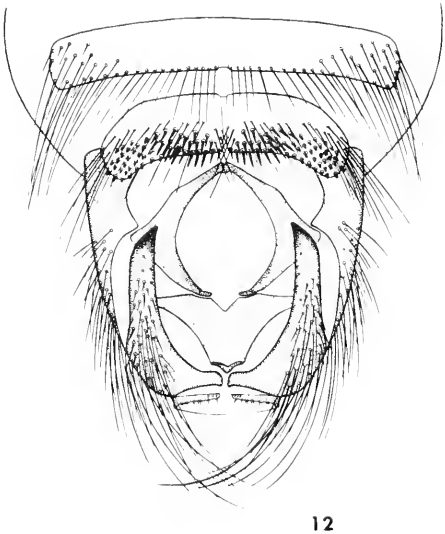
THORAX. Wider than long; length to width = 2 : 3. Mesonotum wide, nearly parallel-sided with a large posterior plate. About 15 notopleural setae which are double anteriorly and posteriorly, the row is single in the middle and the setae more widely spaced. Lateral plate of the notopleural suture narrow, parallel-sided (Fig. 10). Femora very thick, twice as wide as the tibiae, uniformly covered with long thin setae on the anterior and dorsal surface. Tibiae slender, 4.5 times as long as wide, with 4 rows of long setae, the distal row very near the tip and reaching beyond it; dorsal side thickly covered with long, thin setae (Fig. 11).

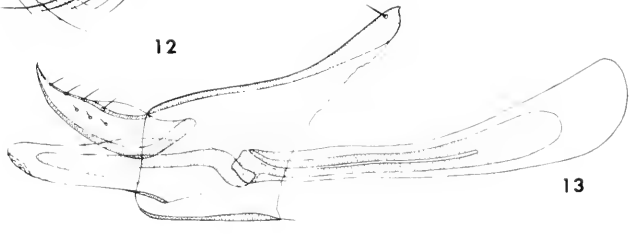
ABDOMEN. Tergite I broadly rounded, with pigmented rounded stripes laterally. Tergites II - VI and anal segment uniformly and densely covered with long, thin, light brown setae. Sternite I + II rounded, with a ctenidium of 40 short spines which are longer laterally; the spaces between the spines are as wide as the spines in the middle and slightly wider laterally; some long preapical setae laterally and a few short setae between the spines. Sternites III and

3 O. Theodor, An illustrated catalogue of the Nycteribiidae in the Rothschild Collection and the British Museum. In press.









Figs. 10-13, *Penicillidia godivae* n. sp., male. 10, dorsal pattern of thorax; 11, mid leg; 12, sternites IV and V and genital area; 13, genitalia.

IV short and wide, with marginal rows of long setae laterally and shorter setae in the middle; some setae laterally on the surface, middle bare. Sternite V much less wide, concave posteriorly, incompletely divided in the middle, with two flat, rounded, lateral processes with about 30 short, thick spines which are characteristic for the *dufourii* group; adjacent to them, towards the middle, two groups of longer spines in 2 - 3 rows which reach nearly to the middle, and between them a few thin setae; anterior to the spines, a row of long, thin setae and a group of such setae laterally (Fig. 12).

GENITALIA (Figs. 12-13). Clasper thick, slightly curved, with a dark point and many setae on the dorsal side in the basal half. Basal arc with triangular halves. Basal plate triangular, with an indentation anteriorly. Two short setae near the base of the phallobase. Aedeagus straight, with rounded tip and small spines at the ventral side of the anterior membranous end. Paramere triangular, with a curved ventral margin and a relatively long, pointed tip; 4 short setae at the dorsal margin and a few minute hairs at the sides.

FEMALE unknown.

The species belongs to the *dufourii* group and is the first representative of this group to be found outside the Palaearctic Region. It differs from the other species of the group in the absence of long and strong setae which are replaced by a large number of very fine and long setae. The male differs also in the arrangement of the spines on sternite V and in details of the genitalia.

Holotype male (A.P.23474) from *Pipistrellus ridleyi*, Singapore, November, 1941. Coll. W. L. Jellison. Type deposited in the Chicago Natural History Museum.

UNDESCRIBED SPECIES OF NEARCTIC TIPULIDAE (DIPTERA) V.

Charles P. Alexander[1]

The crane-flies discussed at this time are from California where they were derived from a variety of sources and taken by different collectors as indicated under the individual species. The materials were found in collections that are being studied in conjunction with the preparation of the Insect Survey Bulletin covering the Tipulidae and related families. I express my thanks to the entomologists who have taken these specimens, some representing species of unusual interest.

Pedicia (Pedicia) bellamyana, n.sp.

Generally similar to *magnifica* in the wing pattern; wings narrow, cell M_1 lacking.

FEMALE.— Length about 28 mm.; wing 22.5 x 4.6 mm.

Rostrum buffy brown, apical margin narrowly darker brown; palpi brown, terminal segment darker. Antennae with scape and pedicel obscure yellow; flagellum broken. Head brownish gray, more buffy behind; vertical tubercle very conspicuous by a circular basal impression.

Pronotum yellowed, sides of scutum and adjacent edge of propleura with a brown area. Mesonotal praescutum grayish white with four stripes, the narrow intermediate pair chestnut brown, narrowed behind, reaching the suture, the central ground area obscured, especially in front; lateral stripes broader but much paler; a small darkened mark on scutum behind the point of the suture; scutal lobes very pale brown; posterior sclerites of notum whitened, the anterior part of the pleurotergite a trifle darker. Pleura light yellow, the pteropleurite whitened; margins of the dorsopleural membrane with very narrow interrupted brown lines. Halteres with stem whitened, knob light brown. Legs with coxae grayish yellow, trochanters slightly darker; remainder of legs obscure yellow, outer tarsal segments a trifle darker, ventrally with dense darkened setae. Wings narrow, as shown by the measurements; the restricted ground whitened, with the dark pattern arranged much as in *magnifica*, that is, with a broad pale brown posterior border, interrupted only in cell R_4; darkened costal border broad, palest in base of cell C; central stripe darkest, behind narrowly bordered by still darker, this color also on the cephalic edge of the stripe before the cord and on the posterior margin of the costal darkening behind *Rs*; no darkened extension on the central darkening along the distal section of Cu_1; veins yellowed. Venation: Sc_2 opposite origin of *Rs*, the latter very long; R_{1+2} nearly four times R_2; *r-m* at or just beyond fork of *Rs*; petiole of cell R_4 relatively long, exceeding one-half *r-m*; cell M_1 lacking;

1. Amherst, Massachusetts.

cord very oblique, inner end of cell *1st* M_2 acutely pointed; *m-cu* gently sinuous; cell M_4 relatively narrow.

Abdomen elongate; tergites buffy, segments one to three with a median brown stripe, darkest on the first segment, narrowed on the third, becoming obsolete behind; sternites more yellowed, basal two segments with a paler brown central line.

HABITAT.— California (Tulare and Plumas Counties).

HOLOTYPE, ♀, Mineral King, south of Sequoia National Park, Tulare County, September 2, 1962 (Richard A. Bellamy); Alexander Collection through Richard E. Bellamy. PARATYPE, ♀, Benner Creek, 6 miles northwest of Chester on Juniper Lake Road, Plumas County, August 20, 1963 (Mrs. LaVerne Erwin); collection of San Jose State College.

I take pleasure in dedicating this species to Dr. Richard E. Bellamy, fellow worker on the Tipulidae. This striking fly is most similar to *Pedicia* (*Pedicia*) *magnifica* Hine (British Columbia, Idaho, Oregon), differing evidently in the narrow wings and the loss of cell M_1. This latter character is identical in both specimens that are available and must be assumed to represent a normal condition, unique among the approximately twenty known species of the subgenus.

Dicranota (*Rhaphidolabis*) *sanctaeluciae*, n.sp.

Allied to *stigma* and *uniplagia;* mesonotum gray, praescutum with three black stripes; legs black, femoral bases more yellowed; wings weaky suffused, stigma large, darker brown; *r-m* at or just beyond the fork of R_{4+5}; male hypopygium with the emargination of the tergite relatively narrow, lateral tergal armature not spinoid; dististyle relatively stout.

MALE.— Length about 7 mm.; wing 8 mm.; antenna about 1mm.

Rostrum gray; palpi black. Antennae short, 14-segmented, black; first flagellar segment elongate, subequal to segments two and three combined, remaining segments short-subcylindrical, the outer ones longer, subequal to their verticils. Head gray.

Pronotum dark gray. Mesonotum gray, praescutum with three black stripes, the central one broad; vestiture of the interspaces long, yellow; scutal lobes extensively blackened. Pleura dark gray; dorsopleural membrane obscure brownish yellow. Halteres with stem yellow, knob infuscated. Legs with coxae gray; trochanters brownish yelow; remainder of legs brownish back to black, femoral bases more yellowed. Wings weakly suffused; stigma large, darker brown; veins brownish black. Venation: *r-m* at or just beyond the fork of R_{4+5}; fork of M_{1+2} short.

Abdominal tergites brownish gray, the posterior borders very narrowly yellow; sternites paler brown; vestiture of segments long and conspicuous, yellow. Male hypopygium with the tergite very large, much as in *uniplagia*; posterior border with a narrow U-shaped emargination, the broad lateral lobes obliquely truncated, provided with abundant long setae; lateral tergal spines not clearly developed, as in *uniplagia*. Basistyle with outer apical lobe small, with very

long setae and two or three short blackened spinoid setae; inner lobe larger, with numerous blackened spinoid setae. Dististyle relatively stout, with a strong lateral carina.

HABITAT.— California (Monterey County).

HOLOTYPE, ♂, Salmon Creek, Santa Lucia Mountains, Los Padres National Forest, along a small rocky tributary on rocks close to water, May 2, 1964 (C. P. Alexander); Alexander Collection. PARATOPOTYPES, 3 ♂♂, (Dennis Hynes); Hynes Collection. Nos. 1243, 1244, 1245, male hypopygia on microscope slides.

Doctor Hynes and I collected this species while on a trip into the Santa Lucia Mountains, a wonderful rugged area that evidently supports a rich and varied crane-fly fauna that is becoming known through the efforts of Dr. Hynes. The only other regional species having male hypopygia with the tergite emarginate as in this fly are *Dicranota* (*Rhaphidolabis*) *stigma* Alexander, of Washington, and *D.* (*R.*) *uniplagia* Alexander, of Oregon, both readily separated by the details of venation and structure of the hypopygium, as described. There is no darkened discal cloud on the wing such as is found in *uniplagia*.

Phyllolabis hurdi, n.sp.

Size relatively large (wing of male 9.5 mm.); general coloration gray, praescutum with three brown stripes; wings whitened, restrictedly patterned with brown, including seams at cord and origin of *Rs;* no stigmal trichia; vein R_1 perpendicular at origin, with a conspicuous spur; male hypopygium with the basistyle tumid, outer end narrowed and decurved; lobe of ninth sternite massive, very large and complex.

MALE.— Length about 8.5 mm.; wing 9.5 mm.; antenna about 2 mm.

Rostrum dark gray; palpi brownish black. Antennae brownish black, scape more pruinose; flagellar segments long-oval to elongate, exceeding their verticils. Head light gray.

Pronotal scutum gray, vaguely patterned with pale brown; a group of black setae at each posterior angle. Mesonotal praescutum clear gray with three brown stripes; central vitta broad, not reaching the suture; pseudosutural foveae black; scutum and postnotum gray, each scutal lobe with two brown areas, the lateral one larger; posterior border of scutellum slightly more reddened. Pleura gray. Halteres whitened. Legs with all coxae and trochanters yellow; femora brownish yellow, tibiae darker, tarsi passing into dark brown. Wings whitened, restrictedly patterned with brown, the markings restricted to the vicinity of the veins, including broad seams at origin of *Rs* and over the cord, with narrower areas on *m* and basal section of vein R_1; veins brown. Venation: Both Sc_1 and Sc_2 beyond the fork of *Rs*; R_{2+3+4} longer than R_{3}; R_1 perpendicular at origin, at the bend with a long spur directed basad; weak spurs near origin of *Rs* and near the cephalic end of basal section of M_{1+2}, both directed basad; basal section of M_3 long, exceeding twice *m*. No stigmal trichia, such as present in *encousta;* macrotrichia on longi-

tudinal veins, sparse and scattered on basal third of *Sc*, lacking on bases of Cu_1 and *2nd A*.

Abdomen brown. Male hypopygium with the posterior border of tergite terminating in a compact group of a few elongate setae. Basistyle tumid, narrowed outwardly, the tip slightly decurved, obtuse before apex with a lateral flange, nearer the base with a group of about 12 strong setae arranged in a double row. Dististyle subterminal, bilobed, the larger lobe pendant at base of style with a longer whitened lobe provided with many long delicate white setae from conspicuous brown punctures to produce a freckled appearance. Appendage of ninth sternite massive, very large and complex in structure, projecting caudad beyond the level of the basistyle.

HABITAT.— California (Madera County).

HOLOTYPE, ♂, San Joachim Experiment Station, February 22, 1953 (P. D. Hurd, Jr.); California Insect Survey Collection.

I am pleased to dedicate the species to the collector, Dr. Paul D. Hurd, Jr., student of the Hymenoptera. This is an unsually distinct species, differing from all others in the Neararctic fauna by the wing pattern and hypopygial structure. The only other regional species with patterned wings is *Phyllolabis myriosticta* Alexander which has abundant brown spots and dots in all the cells and with the hypopygial structure entirely different.

Limnophila (*Phylidorea*) *burdicki*, n.sp.

General coloration of thorax dull fulvous to light brown; antennal flagellum obscure yellow; knobs of halteres darkened; femora obscure yellow, narrowly darkened at and before tips; wings whitish, restrictedly patterned with brown, including the wing tip, *Cu* and Anal veins; abdomen fulvous yellow, the outer three or four segments blackened; male hypopygium with the tergal lobe divided, each lobule blackened, with a conspicuous lateral extension or flange; inner gonapophysis slender, straight; all three filaments of aedeagus elongate, subequal in length and diameter, the paired elements slightly expanded at tips.

MALE.— Length about 12 - 13 mm.; wing 11 - 12 mm.

FEMALE.— Length about 13 mm.; wing 12 mm.

Rostrum brownish black; palpi black. Antennae with scape light brown, remainder of organ obscure yellow; flagellar segments shorter than their verticils. Head light gray.

Thoracic dorsum almost uniformly dull fulvous to light brown, the posterior sclerites and pleura more whitened to appear pruinose. Halteres pale, knobs darkened. Legs with coxae reddish brown; trochanters fulvous; femora obscure yellow, fore pair with tips narrowly more darkened, the other legs with the marking slightly more subterminal, in cases the femora more uniformly pale throughout; tarsi darkened. Wings whitish, stigma oval, dark brown; a restricted but evident paler brown pattern that includes seams over cord and along vein *Cu*, the wing tip and anal veins more diffusely darkened.

Abdomen fulvous yellow, the outer three or four segments more blackened, the dististyles of the male hypopygium more brightened. Male hypopygium with the tergal lobe divided medially by pale membrane, each lobule blackened, with a conspicuous lateral extension or flange. Outer dististyle with distal end triangularly expanded, the outer angle farther produced; inner style with base slightly expanded, outer half slender. Lateral arms pale, triangularly expanded outwardly. Gonapophyses with basal struts longer than the unsually slender straight outer rods. Aedeagus with all three filaments elongate, subequal in length and diameter, the paired elements slightly expanded at tips.

HABITAT.— California (Sonoma County).

HOLOTYPE, ♂, 4 miles west of Plantation, May 1, 1958 (Donald Burdick); California Insect Survey Collection. ALLOTOPOTYPE, ♀, pinned with type. PARATOPOTYPES, 3 ♂♂, May 1 - 8, 1958.

The species is named for the collector, Dr. Donald Burdick. The most similar species include *Limnophila* (*Phylidorea*) *columbiana* Alexander and *L.* (*P.*) *snoqualmiensis* Alexander, which differ in slight details of coloration of the body, legs and wings and in hypopygial structure. The lateral filaments of the aedeagus in both of these species are very slender and not at all expanded at their tips. The superficially similar regional species *L.* (*P.*) *flavapila* Doane is readily told by the entire median tergal lobe of the hypopygium.

Rhabdomastix (*Sacandaga*) *neolurida flaviventris*, n. subsp.

Most similar to *Rhabdomastix* (*Sacandaga*) *neolurida setigera* Alexander (Colorado), differing in slight details of coloration and trichiation of the wing veins. Antennae shorter. Wings broad, as in *setigera*, the cells correspondingly widened; vein *2nd A* without trichia. Abdomen, including the hypopygium, yellowed.

HABITAT.— California (San Bernardino County).

HOLOTYPE, ♂, Barton Flats, San Bernardino Mountains, 6300 feet, July 31, 1946 (John Sperry); Alexander Collection.

Ormosia (*Ormosia*) *nobilis*, n.sp.

Size very large (wing and body about 10 mm.); antennae of male very long; general coloration of mesonotal praescutum light cinnamon with three brown stripes, pseudosutural fovae black, conspicuous; femora obscure yellow, tibiae and tarsi brown; male hypopygium with the tergite broad, apex very shallowly emarginate, the outer lobes with dense setal brushes; phallosome including a Y-shaped central structure and paired gonaphphyses.

MALE.— Length about 10 mm.; wing 10 mm.; antenna about 9 mm.

Rostrum and palpi brownish black. Antennae of male very long, nearly equal to the body or wing; scape and pedicel brownish yellow, flagellum dark brown; flagellar segments elongate subcylindrical, a little more thickened at their bases, with long outspreading

setae, those near base of segment longest, exceeding one-half the segment, the longest subequal to the blackened verticils. Head dark brown.

Pronotal scutum medium brown, scutellum obscure yellow. Mesonotal praescutum light cinnamon or dull orange, with three brown stripes, the median one broad; tuberculate pits and pseudosutural foveae black, the latter conspicuous; scutum chiefly dark brown, the posterior callosities yellowed; scutellum brownish yellow, postnotum a little darker. Pleura brown, vaguely patterned with brighter, especially on the propleura and mesepisternum. Halteres whitish yellow, the knobs more orange yellow. Legs with coxae brownish yellow; trochanters yellow; femora obscure yellow, tibiae and tarsi brown. Wings (a single wing of type present) weakly infuscated, stigma slightly darker; veins brown. Venation: Sc_1 ending just beyond the level of R_2, the latter shorter than R_{2+3}; cell *2nd* M_2 nearly five times its petiole; *m-cu* at fork of M; vein *2nd A* gently sinuous on outer half.

Abdomen dark brown, hypopygium a trifle paler. Male hypopygium with the tergite broad, slightly narrowed on outer half, posterior border very shallowly emarginate to form low broad lateral lobes that bear dense brushes of relatively long setae. Apex of basistyle produced into a lobe. Outer dististyle narrowly scoop-shaped, outer face blackened, microscopically scabrous, mesal part pale with delicate blackened setae; inner style subequal in length, broader, horn-yellow, glabrous. Phallosome including the slender aedeagus, a conspicuous Y-shaped central structure and paired gonapophyses that appear as strong curved hooks, their blackened tips acute, with extensive flattened basal expansions that are not in condition to describe or figure further on the present material.

Habitat.— California (Alameda County).

Holotype, ♂, Berkeley, November 18, 1951 (J. W. Hinerman); California Insect Survey Collection.

This is the largest and most conspicuous American member of the subgenus. It is most similar to species such as *Ormosia* (*Ormosia*) *perspectabilis* Alexander and *O.* (*O.*) *upsilon* Alexander in the elongate male antennae, differing in the great length of the latter, and in the hypopygial structure, particularly the tergite, dististyles and phallosome.

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The new genera and species described in this volume appear in bold face type in this index.