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# BIOLOGICAL SCIENCES

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STANFORD UNIVERSITY, CALIFORNIA
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Press

## CONTENTS

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# Scale Insects of the Santa Cruz Peninsula

BY

GORDON FLOYD FERRIS
Instructor in Entomology

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Fig. 1.—Sketch Map of California; the black area is the Santa Cruz Peninsula.

# INTRODUCTION

It is probable that the scale-insect fauna of no area of comparable extent, unless it be that of the region surrounding the Mesilla Valley in New Mexico, is better known than is that of the Santa Cruz Peninsula in California. Nor is it probable that there are many areas of similar extent in which this group of insects is represented by a larger or more diversified list of species. Small as this peninsula is, more species are now known to occur *out of doors* within it than have been recorded in any of the various state lists that have been published (deducting synonyms), and it should be borne in mind that in all these lists there are included numerous species known only from their occurrence in greenhouses.

This richness of the Coccid fauna of the Santa Cruz Peninsula is due in part to the fact that many introduced species which are found only in greenhouses throughout much of the United States are here able to thrive out of doors. Nevertheless, of the ninety-two species recorded in this paper sixty are presumably native. The extent of our knowledge of these species is due to the efforts of a long series of students who for twenty years or more have been adding to it. A total of forty-six species, of which seven are now regarded as synonyms, have their type locality within this area.

The accompanying sketch map (Fig. 1) will give some idea of the size of this peninsula as compared with the entire state of California. For the purposes of this paper the Santa Cruz Peninsula is regarded as bounded on the south by a line drawn from Santa Cruz to San Jose and thence to the southern extremity of San Francisco Bay.

The presentation of a local list is but a small part of the real purpose of this paper. In the case of many of the included species the existing descriptions are in need of amplification, and in the case of many more the available figures (if, indeed, there be any) are inadequate. The opportunity has therefore been taken especially to present figures of numerous species. There is also included a considerable amount of information having to do with locality and host records and synonymy, together with discussions of certain matters of more general interest.

There are recorded in this list only species occurring out of doors. Were greenhouse species likewise to be considered, the list might be extended almost indefinitely.

The types of all new species herein described are in the Stanford University collection of Coccidæ.

# SYNONYMICAL LIST OF SPECIES

Note.—Names in italics are synonyms. Only those names are included that have been used in referring to these species as they occur in California and the synonymy has not been carried back of the Fernald Catalogue. Species of which the type locality is on the Santa Cruz Peninsula are indicated by an asterisk.

## Genus **ICERYA** Sign.

purchasi Maskell.

## Genus **XYLOCOCCUS** Loew.

*quercus Ehrh.

## Genus **STOMACOCCUS** Ferris.

*platani Ferris.

## Genus **ORTHEZIA** Bosc.

**californica* Ehrh.
occidentalis Douglas.
occidentalis Douglas.
**californica* Ehrh.

## Genus **ASTEROLECANIUM** Targ.

variolosum (Ratz.)

## Genus **MYCETOCOCCUS** Ferris.

*ehrhorni (Ckll.).
**Cerococcus ehrhorni* Ckll.

## Genus **CEROCOCCUS** Comst.

**ehrhorni* Ckll.
*Mycetococcus ehrhorni (Ckll.).

## Genus **EHRHORNIA** Ferris.

cupressi (Ehrh.).
*Sphaerococcus cupressi* Ehrh.
graminis Ferris

## Genus **SPHÆROCOCCUS** Maskell.

*cupressi* Ehrh.
Ehrhornia cupressi (Ehrh.).
**disticlium* Kuwana.
*Paludicoccus disticlium (Kuwana).

## Genus **PALUDICOCCUS** Ferris.

*disticlium (Kuwana).
**Sphaerococcus disticlium* Kuwana.

## Genus **ERIOCOCCUS** Targ.

*adenostomae Ehrh.
araucariae Maskell.
**artemisiae* Kuwana.
    Erium lichtensioides (Ckll.).
*bahiae Ehrh.
*catalinae* Ehrh.
    Erium lichtensioides (Ckll.).
paenulatus n. sp.
quercus (Comst.).
*salinus Ehrh.*
    Cryptoripersia arizonensis (Ehrh.).
*stanfordianus n. sp.
*villosus n. sp.

## Genus **GOSSYPARIA** Sign.

spuria (Modeer).

## Genus **KERMES** Boit.

*cockerelli Ehrh.
*essigii* King.
    nigropunctatus Ehrh.
nigropunctatus Ehrh.
    *essigii* King.
**mirabilis* King.
    *rattani Ehrh.
*rattani, Ehrh.
    **mirabilis* King.

## Genus **PHENACOCCUS** Ckll.

*artemisiae Ehrh.
**bahiae* Ehrh.
    Puto yuccae (Coq.).
*colemani Ehrh.
*eriogoni Ferris.
*solani Ferris.
*stachyos Ehrh.

## Genus **CEROPUTO** Sulc.

With all included species a synonym of *Puto.*

## Genus **PUTO** Sign.

*ambigua (Full.).
    **Ceroputo ambigua* Full.
cupressi (Coleman).
    *Pseudococcus cupressi* Coleman.
    **Pseudococcus sequoiae* Coleman (as to male).
yuccae (Coq.).
    **Phenacoccus bahiae* Ehrh.
    **Ceroputo bahiae* (Ehrh.).

## Genus **PSEUDOCOCCUS** Westwood.

*andersoni* Coleman.
    ryani (Coq.).
*artemisiae* Essig.
    Erium lichtensioides (Ckll.).
aurilanatus (Maskell).
*bakeri* Essig.
    *maritimus Ehrh.
*citrophilus* Clausen.
    gahani Green.
crawii (Coq.).
    **quercus* Ehrh. (in part).
*eriogoni Ehrh.
    **Erium eriogoni* (Ehrh.).
    *Pseudococcus yerba-santae* Essig.
gahani Green
    *citrophilus* Clausen.
*longisetosus Ferris.
*maritimus Ehrh.
    *bakeri* Essig.
    *obscurus* Essig.
*obscurus* Essig.
    *maritimus Ehrh.
**quercicolus* Ferris.
    *quercus (Ehrh.) (in part).
*quercus Ehrh. (in part).
    **quercicolus* Ferris.
**quercus* Ehrh. (in part).
    crawii (Coq.).
ryani (Coq.).
    *andersoni* (Coleman).
sequoiae (Coleman) (as to female).
*sequoiae* (Coleman) (as to male).
    Puto cupressi (Coleman).
salinus Ckll.
*smithii* (Essig.) (in part).
    *Trionymus californicus* Ehrh.
*timberlakei Ckll.
*yerba-santae* Essig.
    eriogonj (Ehrh.).

## Genus **ERIUM** Ckll.

**eriogoni* (Ehrh.).
    Pseudococcus eriogoni (Ehrh.).
lichtensioides (Ckll.)
    **Eriococcus artemisiae* Kuwana.
    *Eriococcus catalinae* Ehrh.
    *Pseudococcus artemisiae* Essig.

## Genus **TRIONYMUS** Berg.

*bromi Ferris.
californicus Ehrh.
*Ripersia smithii* Essig (in part).
*Pseudococcus smithii* (Essig) (in part).
*distichlii Ferris.
*festucæ (Kuwana).
**Ripersia festucae* Kuwana.
smithii (Essig) (in part).
*Ripersia smithii* Essig (in part).
*Pseudococcus smithii* (Essig) (in part).
villosa (Ehrh.).
*Ripersia villosa* Ehrh.

## Genus **RIPERSIA** Sign.

**festucae* Kuwana.
*Trionymus festucae (Kuwana).
smithii Essig (in part).
Trionymus smithii (Essig).
*smithii* Essig (in part).
Trionymus californicus Ehrh.
*villosa* Ehrh.
Trionymus villosus (Ehrh.).

## Genus **RIPERSIELLA** Towns.

*kelloggi Ehrh.

## Genus **CRYPTORIPERSIA** Ckll.

arizonensis (Ehrh.).
*Eriococcus salinus* Ehrh.
*Cryptoripersia salinus* (Ehrh.)

## Genus **ACLERDA** Sign.

*californica (Ehrh.).
tokionis (Ckll.).

## Genus **PULVINARIA** Targ.

*ehrhorni King.
*rhois Ehrh.
vitis (Linn.).

## Genus **COCCUS** Linn.

citricola Campbell.
hesperidum Linn.

## Genus **TOUMEYELLA** Ckll.

*pinicola n. sp.

### Genus **LECANIUM** Ill.

**adenostomae* Kuwana.
    corni (Bouché).
cerasorum Ckll.
corni (Bouché).
    **adenostomae* Kuwana.
    **crawii* Ehrh.
**crawii* Ehrh.
    corni (Bouché)
*excrescens n. sp.
**magnoliarum* Ckll.
    persicae Fab.
persicae Fab.
    **magnoliarum* Ckll.
pruinosum Coq.
*pubescens Ehrh.

### Genus **SAISSETIA** Dep.

nigra (Nietn.).
oleae (Bern.).

### Genus **PHYSOKERMES** Targ.

*insignicola (Craw).
*taxifoliae Coleman.

### Genus **CHIONASPIS** Sign.

quercus Comst.
pinifoliae (Fitch).
spartinae Comst.

### Genus **DIASPIS** Costa.

carueli Targ.
manzanitae (Whitney).
echinocacti (Bouché).
piricola (Del Guer.).
    *Epidiaspis piricola* (Del Guer.).

### Genus **AULACASPIS** Ckll.

rosae (Bouché).

### Genus **EPIDIASPIS** Ckll.

    Regarded as a synonym of *Diaspis*.
*piricola* (Del Guer.).
    Diaspis piricola (Del Guer.).

### Genus **LEUCASPIS** Targ.

**kelloggi* Coleman.
    *Dinaspis kelloggi (Coleman).

### Genus **DINASPIS** Leon.

*kelloggi (Coleman).
    **Leucaspis kelloggi* Coleman.

## Genus **LEPIDOSAPHES** Shimer.

newsteadi (Sulc).
ulmi (Linn.).

## Genus **ASPIDIOTUS** Bouché.

arctostaphyli Ckll. and Rob.
*aesculi Johns.
*abietis* Comst. (misidentification).
    pini Comst.
*californicus* Coleman.
    pini Comst.
coniferarum Ckll.
*coniferarum* var. *shastae* Coleman.
    shastae Coleman.
densiflorae Bremner.
ehrhorni Coleman.
hederae (Vall.)
osborni Ckll.
    *yulupae* Bremner.
perniciosus Comst.
pini Comst.
    *abietis* Comst. (misidentification).
    *californicus* Coleman.
rapax Comst.
shastae Coleman.
    *coniferarum* var. *shastae* Coleman.
*yulupae* Bremner.
    osborni Ckll.

## Genus **CHRYSOMPHALUS** Ashmead.

rossi (Maskell).

## Genus **TARGIONIA** Sign.

dearnessi Ckll.

## Genus **ODONASPIS** Leon.

*graminis Bremner.

# DISCUSSION OF GENERA AND SPECIES

## Genus **ICERYA** Sign.

### **Icerya purchasi** Maskell.

It will be remembered that this species was originally introduced into the United States at a point in this area. At the present time it occurs rather commonly here, being somewhat of a pest on the pears in the Santa Clara Valley and occasionally killing ornamentals. It has established itself on certain wild plants, especially favoring mistletoe, but also occurring on sage brush (*Artemisia californica*) and chamiso (*Adenostoma fasciculatum*).

## Genus **XYLOCOCCUS** Loew.

### **Xylococcus quercus** Ehrh.

1917. *Xylococcus quercus* Ehrh.; Florence, *Ann. Ent. Soc. Am.*, **10**:155-8; figs.
1919. *Xylococcus quercus* Ehrh.; Ferris, *Can. Ent.*, **51**:110.

Originally described from *Quercus chrysolepis*, Stevens Creek Canyon, near Mountain View, in this area. I have taken what is probably the same species from *Quercus californicus* in the hills above Searsville Lake. The species appears to be rather rare and very local in occurrence.

As I have elsewhere pointed out (ref. cited) it is somewhat doubtful that this species is distinct from *X. betulæ* Perg. I have specimens of all the critical stages of both species and find that the two differ only in the number of median, ventral pores in the first larval stage, *betulæ* having five or six of these pores and *quercus* two. However, in specimens from *Quercus californicus* there are as many as nine of these pores. Either the specimens from the two species of oaks should be regarded as separate species or both should be referred to *betulæ*. I am inclined to favor the latter view, but the examination of more material is desirable.

## Genus **STOMACOCCUS** Ferris.

1917. Ferris, *Can. Ent.*, **49**:375.

This genus was originally based chiefly upon the presence of mouthparts in the adult female, but this character is not sufficient to distinguish it, as other genera of this group are now known to possess mouthparts in the adult female. I append the following recharacterization of the genus.

Monophleboid Coccidæ in which the legs are lacking in the intermediate stages of the female; immature stages without an anal tube; adult female with mouthparts, with digitules on the claw and without knobbed hairs at the tip of the tibia, without reticulations on the legs and antennæ, with 7-segmented antennæ; all stages (except perhaps the first) with six pairs of abdominal spiracles; adult male wingless, without compound eyes.

Notes: It is possible that this genus should be merged with *Steingelia*, but the male of *S. britannica* (Green) is winged. Until the intermediate stages of *Steingelia* have been described it may be well to maintain the two genera as distinct.

### **Stomacoccus platani** Ferris.

Originally described from this area where it is abundant on the native sycamore, *Platanus racemosa*. It has also been taken from *P. occidentalis*, an introduced species within this area.

## Genus **ORTHEZIA** Bosc.

### **Orthezia occidentalis** Douglas.

*Orthezia californica* Ehrh. appears to be the same as *O. occidentalis*. I have received a specimen of the latter from Professor Cockerell and am unable to detect any differences.

This species is rather common, occurring on the crowns and roots of various plants, especially *Eriophyllum confertiflorum*. I have once taken it from cells in the hard, dry soil clinging to the roots of a species of *Dudleya* on the cliffs near New Years Point.

## Genus **ASTEROLECANIUM** Targ.

### **Asterolecanium variolosum** (Ratz.).

Common on *Quercus agrifolia*, *Q. lobata*, and *Q. douglasii*.

## Genus **MYCETOCOCCUS** Ferris.

### **Mycetococcus ehrhorni** (Ckll.).

1918. *Mycetococcus ehrhorni* (Ckll.); Ferris, *Can. Ent.*, **50**:330, fig. 15A.

This species (formerly referred to *Cerococcus*) was originally described from this area. It occurs only on oaks and probably infests all the local species (including the tan oak, *Pasania densiflora*). It especially favors the live oak, *Q. agrifolia*, the limbs of which are frequently gray with the fungus which is invariably associated with the insect.

## Genus **EHRHORNIA** Ferris.

### **Ehrhornia cupressi** (Ehrh.).

1918. *Ehrhornia cupressi* (Ehrh.); Ferris, *Can. Ent.*, **51**:326.

A serious pest on *Cupressus macrocarpa* and *C. guadelupensis,* which are extensively grown as ornamentals throughout this region. It also occurs on *Libocedrus decurrens* on the campus of Stanford University.

### **Ehrhornia graminis** Ferris.

1918. *Ehrhornia graminis* Ferris, *Can. Ent.*, **51**: 326, fig. 12.

Within this area this species has been taken only from the rootstocks of an undetermined perennial grass growing in the brush on the hills above Scott Creek, Santa Cruz County.

## Genus **PALUDICOCCUS** Ferris.

### *Paludicoccus disticlium* (Kuwana).

1918. *Paludicoccus disticlium* (Kuwana); Ferris, *Can. Ent.*, **50**: 327, fig. 13.

Known only from a grass, *Distichlis spicata,* in the salt marshes about San Francisco Bay.

## Genus **ERIOCOCCUS** Targ.

The present author has had the opportunity of examining specimens of nearly all the species of this genus that have been recorded from North America. In the course of this study it has become apparent that most of the existing descriptions of species are quite inadequate, owing to the fact that too much attention has been paid to characters of but little importance, while those of genuine value have been quite consistently ignored.

The character of the sac is in a few cases of some value, but in general has little significance, there being practically no difference between the sacs of widely differing species. In only a few extreme cases is it important. The character of the legs likewise is of but little use, except in some extreme cases. The antennæ are undoubtedly worthy of some consideration, although the antennal formulæ that have been so extensively used are probably of no special value. The most distinctive characters are to be found in the form, number, and distribution of the spines with which the body is generally more or less thickly beset. In a few cases it appears that the form of the wax ducts may be of some slight use.

Even with the aid of these characters it is often difficult to decide as to the proper disposition of specimens. The amount of material at present

available is not large, but it is sufficient to indicate that there is either an extraordinary amount of variation or that an indefinite number of species separated by infinitesimally small characters must be recognized. The examination of a large mass of material is needed before very definite conclusions may safely be formed.

### **Eriococcus adenostomæ** Ehrh.

Fig. 2.

Originally described from this area where it is quite common on *Adenostoma fasciculatum*. It has been recorded from this host in the southern part of the state also.

*Adult female* with spines present both on dorsum and margins of the body. Spines rather few, of varying sizes, those of the margins not

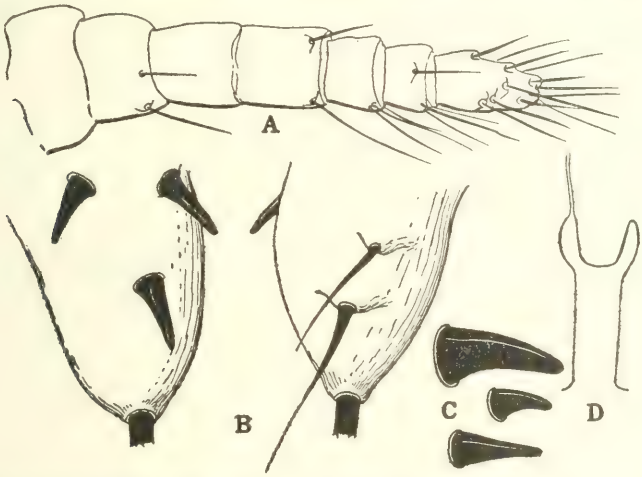


Fig. 2.—*Eriococcus adenostomæ* Ehrh.: *A*, antenna of adult female; *B*, anal lobes, dorsal aspect left, ventral aspect right; *C*, types of spines; *D*, wax duct. From specimen from topotype material.

or but little larger than those of the dorsum, all small but relatively stout and for the most part slightly curved, tapering regularly to the blunt apex (Fig. 2*C*). On each abdominal segment there is a group of three or four spines at each lateral margin, a median group and a submedian group of two or three spines on each side. Anal lobes (Fig. 2*B*) but little, or not at all, chitinized, each with three spines on the dorsum, which are smaller than the largest body spines, and with two slender setæ on the ventral side. Ducts (Fig. 2*D*) with a deep and rather narrow cup at the inner extremity. Antennæ (Fig. 2*A*) noticeably short and stout, normally 7-segmented. Legs likewise rather short and stout, the claw with a distinct tooth beneath. Posterior coxæ bearing numerous rather large pores.

## Eriococcus araucariæ Maskell.

Fig. 3.

1915. *Eriococcus araucariae* Maskell; Essig, "Injurious and Beneficial Insects of California," ed. 2, p. 120, fig. 102.

This is an introduced species found only on *Araucaria*. It probably is generally distributed within this area wherever its host is grown, but I have seen specimens only from Menlo Park.

Essig (ref. cited) has given an excellent photograph of the sac, and I append herewith a description of the morphological characters of the species.

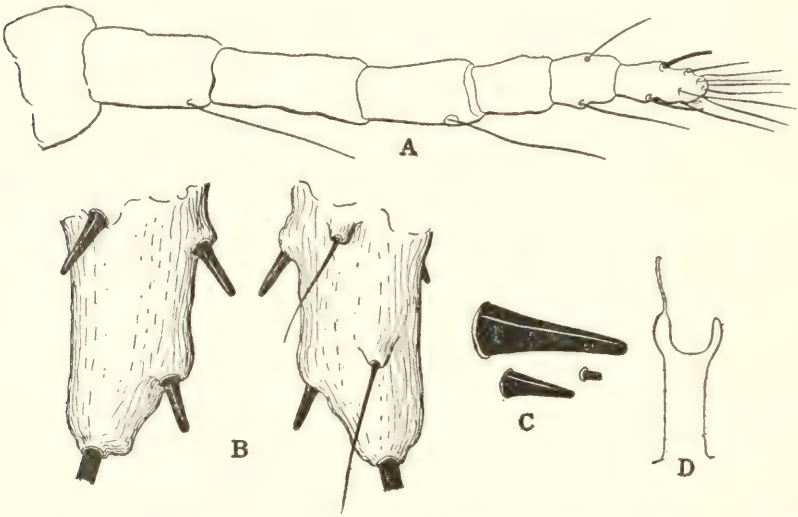


Fig. 3.—*Eriococcus araucariæ* (Maskell): *A*, antenna of adult female; *B*, anal lobes, dorsal aspect left, ventral aspect right; *C*, types of spines, the smallest representing those of the dorsum; *D*, wax duct. From specimen from Santa Cruz Peninsula.

*Adult female* with the marginal spines greatly exceeding in size those of the dorsum (Fig. 3*C*), the latter being quite numerous but very small, cylindrical and truncate at the tip, the former being straight, slightly expanded at the base and then tapering evenly to the tip, which is bluntly rounded or even truncate. The marginal spines are arranged in a definite single row, each abdominal segment bearing three spines at each lateral margin, one of these spines being considerably smaller than the other two. Anal lobes (Fig. 3*B*) heavily chitinized, rather cylindrical in form, each bearing upon the dorsum three spines of about the size of the smaller marginal spines and upon the ventral side a pair of slender setæ. Anal lobe setæ somewhat longer than the anal ring setæ. Antennæ (Fig. 3*A*)

normally 7-segmented, rather long and slender. Legs likewise rather slender, the claw without a tooth, and the posterior coxæ without pores. Ducts (Fig. 3*D*) with a rather broad and deep cup.

Notes: Of the species known to me this most closely resembles *E. coccineus* Ckll., which is found on cactus, but the latter differs in having the marginal spines more numerous and in having a few large spines on the dorsum of the cephalothorax.

### **Eriococcus bahiæ** Ehrh.

Fig. 4

Originally described from the roots of *Eriophyllum* (=*Bahia*) *confertiflorum,* from this area. It occurs quite commonly on this host, and

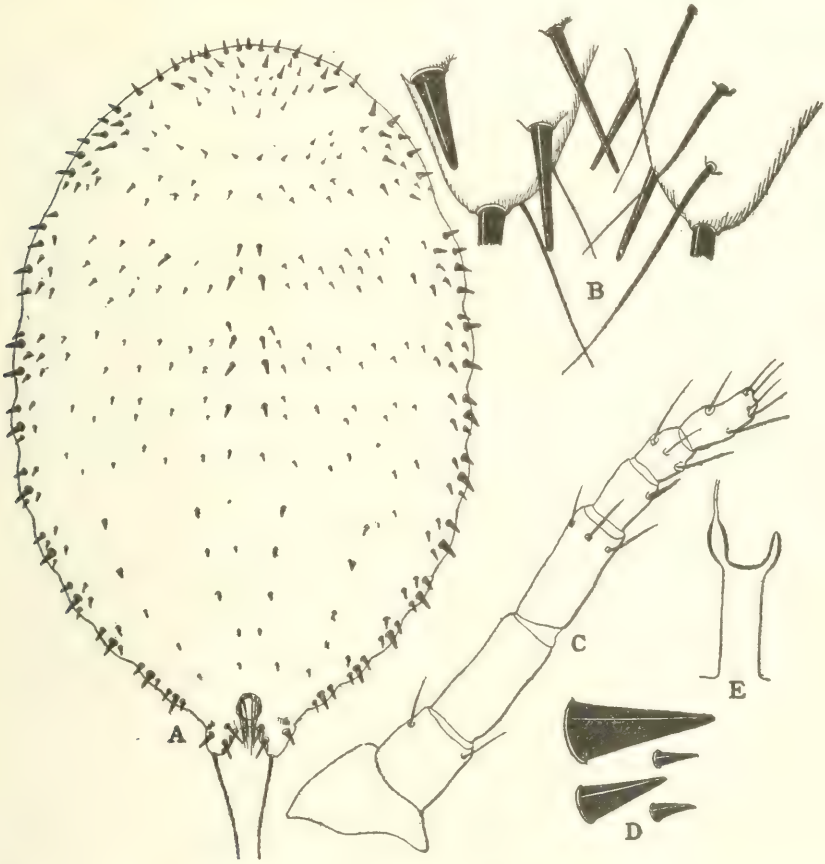


Fig. 4.—*Eriococcus bahiæ* Ehrh.: *A,* dorsal aspect of adult female; *B,* anal lobes, dorsal aspect left, ventral aspect right; *C,* antenna of adult female; *D,* types of spines; *E,* wax duct. From specimen from type material.

I have specimens from *Castilleia* sp. near Woodside, grass near Stanford University and *Quercus agrifolia* near Mountain View that I assign to this species.

*Adult female* (Fig. 4*A*) with the spines of the margins much larger than those of the dorsum, the latter usually quite small. Marginal spines (Fig. 4*D*) (in specimens from the type material) very stout, conical and rather bluntly pointed, of various sizes, each abdominal segment normally with one or two large spines and two or three smaller spines at each lateral margin. Dorsal spines (Fig. 4*D*) resembling those of the margins in form or at times slightly curved, rather few in number, those of the abdomen tending to be arranged in four longitudinal rows, those of the cephalothorax more numerous, scattered, in size merging at the margins with the marginal spines. Anal lobes (Fig. 4*B*) chitinized only along the mesal margin, each with three slender ventral setæ and three dorsal spines of which two are longer and more slender than the marginal spines. Anal lobe setæ nearly three times as long as the anal ring setæ. Antennæ (Fig. 4*C*) moderately slender, normally 7-segmented. Legs likewise moderately slender, the claw with a distinct tooth, the posterior coxæ with a few pores. Ducts (Fig. 4*E*) with a rather deep and slightly asymmetrical cup.

Notes: The above description and the accompanying figures are based upon specimens from the type material, but the species presents a very considerable range of variation. Even in specimens from the type host and the immediate type locality the marginal spines are noticeably longer and more slender than those here figured.

I have at hand a considerable amount of material from localities without this area which represents either extreme variations of *E. bahiae* or several very closely related species. In this material are specimens of *E. costaricensis* Ckll., which differ only in having the spines of the anal lobes slightly smaller than the marginal spines and in having the anal lobes more heavily chitinized; specimens from *Eriogonum* sp. in Owens Valley, California, which differ in having the marginal spines stouter than in *E. bahiae;* specimens from *Gutierrezia* sp. near *Mesilla* Valley, New Mexico, which differ only in having the marginal spines slightly curved, and specimens from the material recorded by Cockerell as *E. palmeri* var. *a* which differ in having the marginal spines larger and slightly differently shaped. Only the examination of a large amount of material from many hosts and localities will permit any definte conclusions as to the proper disposition of these forms.

## **Eriococcus pænulatus** n. sp.

Fig. 5.

*Type host and locality.* From *Artemisia californica,* near Stanford University, California.

*Habit.* Occurring on the smaller stems of the host. Sac white, smooth except for a few projecting threads of wax; length 2.5-3 mm.

*Morphological characteristics.* Spines rather few but present over the entire surface of the dorsum, not arranged in definite rows. The spines are of various sizes, but the largest of the marginal spines are scarcely or not at all larger than those of the dorsum. In form (Fig. 5) they vary from moderately to very stout and are for the most part straight or very slightly curved, slightly expanded at the base and then

Fig. 5.—*Eriococcus pænulatus* n. sp.; types of spines.

tapering in a smooth curve to the bluntly rounded apex. Anal lobes weakly chitinized, each with two slender setæ on the ventral side and three spines on the dorsal side, these somewhat more slender but about the same length as the largest of the body spines. Antennæ 7-segmented. Legs with the tarsus slightly longer than the tibia, the claw with a tooth, the posterior coxæ without pores. Tubular ducts with the cup quite deep, nearly symmetrical. Anal ring with eight setæ, the longest of which are about half as long as the anal lobe setæ.

Notes: I have found this species in but a single restricted locality and there in but small numbers. It somewhat resembles *E. villosus* n. sp., the description of which follows, but the spines are consistently stouter, larger and more bluntly tipped and the posterior coxae are destitute of all but a very few minute pores.

## Eriococcus quercus (Comst.)

Fig. 6.

1915. *Ericoccus quercus* (Comst.); Essig, "Injurious and Beneficial Insects of California," ed. 2, p. 121, fig. 103.

Within this area this species has been taken only from *Quercus agrifolia* at Palo Alto. It is a widely distributed species, occurring throughout the United States on various species of oaks.

Essig (ref. cited) has given an excellent figure of the sac, and a description of this may be omitted, but I append the following notes on the insect itself.

*Adult female* with the dorsum uniformly beset with numerous rather large, slender, tapering, curved, and slightly pointed spines (Fig. 6*C*), those along the margins being somewhat larger than the others. Anal lobes (Fig. 6*B*) heavily chitinized, rather cylindrical, their mesal margins

bearing a number of small, tubercle-like projections, the dorsum with three spines of the same size and shape as those of the body, and the ventral side with a single slender seta. Anal lobe setæ scarcely longer

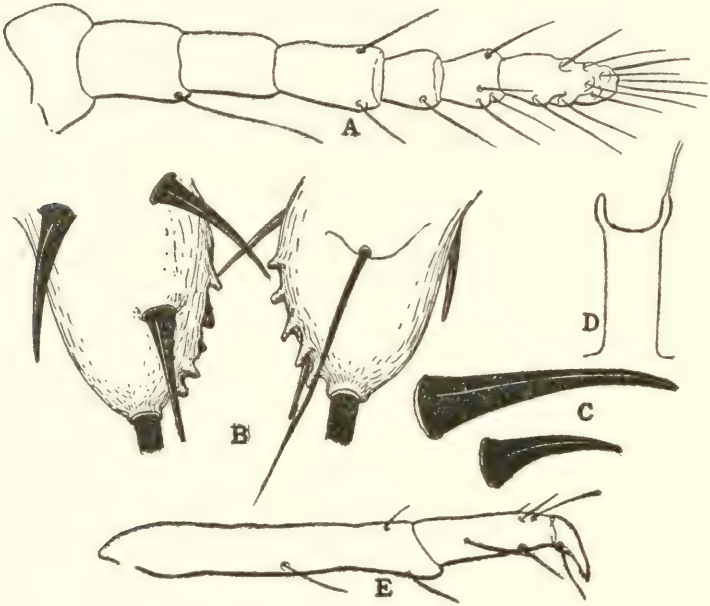


Fig. 6.—*Eriococcus quercus* (Comst.): *A*, antenna of adult female; *B*, anal lobes, dorsal aspect left, ventral aspect right; *C*, types of spines; *D*, wax duct; *E*, tibia and tarsus. From specimen from *Quercus agrifolia*, on the Santa Cruz Peninsula.

than the anal ring setæ. Antennæ (Fig. 6*A*) rather slender, 7-8-segmented. Legs (Fig. 6*E*) quite slender, the tibia always much exceeding the tarsus in length, the claw with a small tooth, the posterior coxæ without pores. Tubular ducts (Fig. 6*D*) with a broad and shallow cup.

Notes: This is a very distinctive species, the form of the spines, the unusual length of the tibia and the tubercles on the anal lobes separating it at once from the other North American representatives of the genus. I have at hand specimens from several localities and while there is evidently a considerable variation in the size of the dorsal spines, these in some cases being much smaller than those of the margin and in others nearly or quite as large, the other characters are so constant that I consider all to belong to the same species. I have not seen the types of *E. howardi* Ehrh. but it is in all probability the same.

The description given above is from specimens from *Quercus agrifolia* at Palo Alto.

**Eriococcus stanfordianus** n. sp.

Fig. 7.

*Type* taken from beneath a stone on Jasper Ridge, near Stanford University, California, November, 1917.

*Sac.* Character not noted.

*Morphological characteristics.* Body (Fig. 7*A*) beset with numerous large spines (Fig. 7*B*), all of which are straight, slightly expanded at the base, tapering thence to the sharply pointed tip. The spines of the

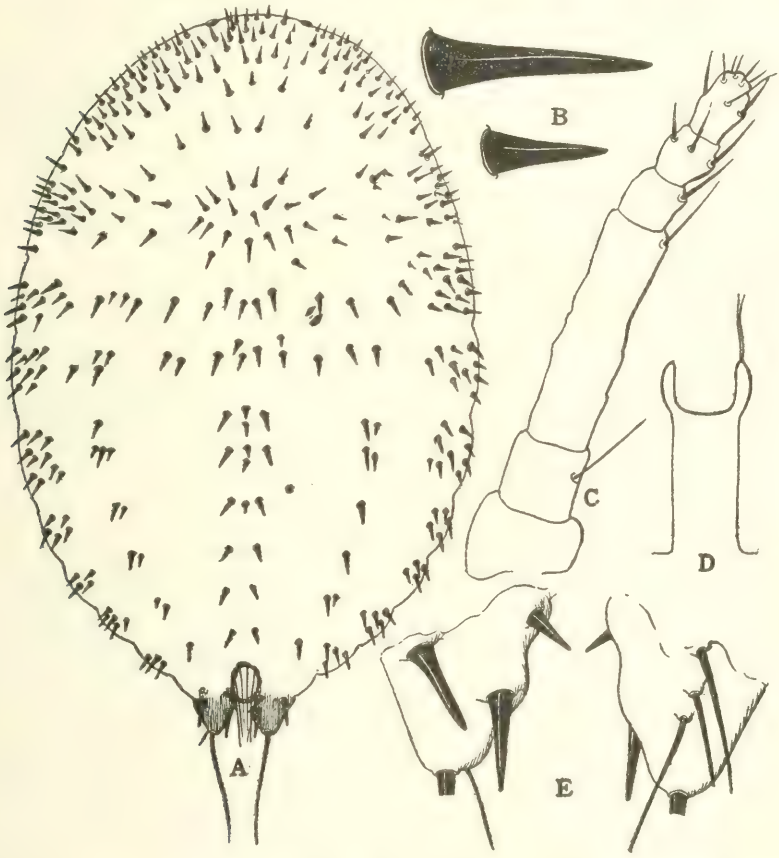


Fig. 7.—*Eriococcus stanfordianus* n. sp.: *A*, dorsal aspect of adult female; *B*, types of spines; *C*, antenna of adult female; *D*, wax duct; *E*, anal lobes, dorsal aspect left, ventral aspect right.

margin do not exceed in size those of the dorsum. On the abdomen the spines are arranged in a quite definite manner, there being on each segment a median group of two or three, one or two spines midway between this group and each margin, and a marginal group of five or six on each

side. On the cephalothorax the spines are more numerous and are irregularly arranged. Anal lobes (Fig. 7*E*) weakly chitinized, each with three slender setæ on the ventral side and three spines on the dorsal side which are of the same shape as the body spines. Antennæ (Fig. 7*C*) rather stout, 6-segmented, the third segment being very long. Legs rather slender, the claw with a very small tooth, the posterior coxæ without pores. Ducts (Fig. 7*D*) with a rather broad and shallow cup. Anal ring with eight setæ which are about half as long as the anal lobe setæ.

Notes: I have but a single specimen of this species from this locality. Certain specimens from *Chamaecyce polycarpa* between Mecca and Blythe, Riverside County, Calif., resemble it in the arrangement of the spines and in the character of the antennae but differ in having the spines smaller and blunter. I am inclined to refer them to this species.

### **Eriococcus villosus** n. sp.

Fig. 8.

*Type host and locality.* From *Eriogonum latifolium,* New Year's Point, Santa Clara County, California, September, 1918.

*Sac* slightly yellowish, its surface with many projecting filaments of wax. All the specimens observed were on the under surface of the leaves, the color and roughness of the sac causing them to resemble very closely the thick tomentum of the leaf.

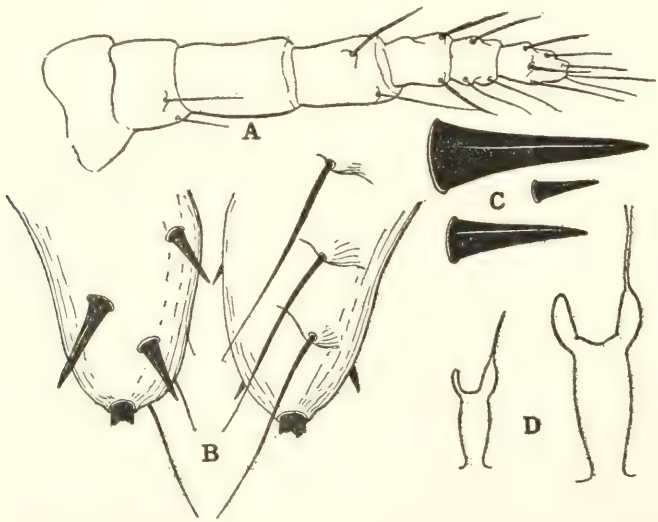


Fig. 8.—*Eriococcus villosus* n. sp.: *A,* antenna of adult female; *B,* anal lobes, dorsal aspect left, ventral aspect right; *C,* types of spines; *D,* wax ducts.

*Morphological characteristics.* Dorsum quite uniformly beset with moderately large spines (Fig. 8*C*) of various sizes, which are straight, somewhat expanded at the base, tapering thence to the sharp point, those of the margins but little or not at all larger than those of the dorsum. Anal lobes (Fig. 8*B*) weakly or not at all chitinized, each with three slender setæ on the ventral side and three spines on the dorsal side, these resembling the majority of the body spines in form and size. Antennæ (Fig. 8*A*) moderately stout, 7-segmented. Legs rather slender, the tibia and tarsus sub-equal, the claw with a tooth, the posterior coxæ with many pores on one side. Ducts (Fig. 8*D*) of two sizes, both with the cup quite deep, the smaller with it somewhat asymmetrical. Anal ring with eight setæ, which are about half as long as the anal lobe setæ.

Notes: It is possible that this is *E. dubius* Ckll., which is a species of very similar character, but I can not definitely connect the two and prefer to give this a name. I have at hand specimens from *Acacia paucispina, Prosopis velutina* and *P. glandulosa* all taken in Arizona, which are possibly this species.

## Genus **GOSSYPARIA** Targ.

### **Gossyparia spuria** (Modeer).

Very abundant on elms on the campus of Stanford University and probably to be found in other parts of this area.

## Genus **KERMES** Boitard.

This genus seems in general to have been somewhat misunderstood, probably in large part because the adults are difficult to study morphologically and because the immature stages have been studied but little. The genus has been placed by some authors in a distinct subfamily, the *Hemicoccinæ*. It should be pointed out that if such a subfamily be recognized the name should stand as *Kermesinæ*, there being no genus *Hemicoccus*. Cockerell, however, has assigned the genus to the tribe *Eriococcini* of the subfamily *Dactylopiinæ*, a position that is without much doubt correct. At least the genus is a member of the group (whatever value may be assigned to it) to which *Eriococcus* belongs. The first stage larva, the wax ducts and the antennæ are strictly of the Eriococcine type.

The separation of the various species of this genus has usually been attempted from a consideration of the adult female without reference to morphological characters. Owing to the extreme chitinization of the derm at maturity it is practically impossible to obtain slide mounts in which anything of value can be seen; but if specimens be taken early in the last instar, before this chitinization has begun, the various structures

can easily be made out. The examination of specimens in this stage will doubtless clear up many questions as to synonymy and should be regarded as an essential part of any studies upon the genus.

As far as I can discover the development of no species of this genus has yet been carefully described. I am therefore discussing at some length the development of *Kermes cockerelli.*

### **Kermes cockerelli** Ehrh.

Figs. 9*C*, 10 and 11.

Originally described from this locality. It has been taken only from *Quercus lobata.*

*Habit* (Fig. 9*C*). Entirely devoid of secretionary covering; color a uniform light brown. There is a deep, median furrow along which there is little or no indication of segmentation, but at the sides of the furrow the intersegmental constrictions are very deep, causing the sides to be extremely gibbous.

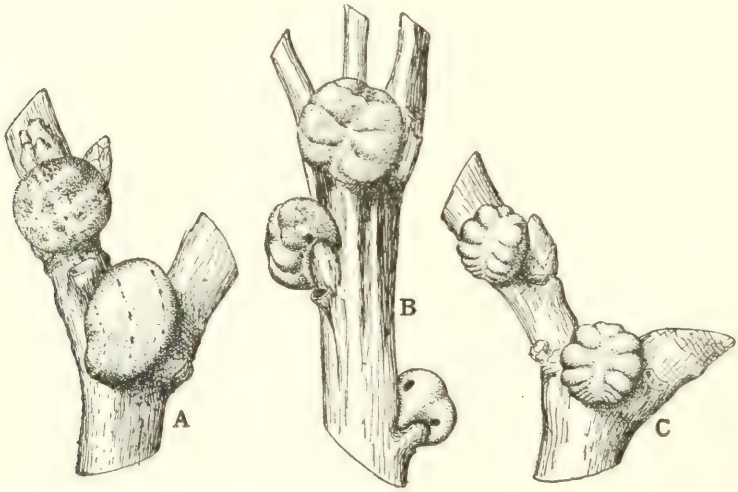


Fig. 9.—*A, Kermes rattani* Ehrh.; *B, Kermes nigropunctatus* Ehrh.; *C, Kermes cockerelli* Ehrh.

*Morphological characteristics.* Specimens of the adult female taken before the derm becomes heavily chitinized (Fig. 10*B*). Antennæ (Fig. 10*A*) short and stout, obscurely 6-segmented with the third segment longest. Legs likewise short and stout, but presenting all the normal parts. Anal lobes represented only by a pair of weakly chitinized areas, each of which bears several small spines. In fully grown specimens these

lobes become almost obliterated. Anal ring borne at the inner end of a short invagination, consisting of a simple, irregular, chitinized ring which bears no setæ. Body with a few stout, sharply pointed spines (Fig. 10*D*) at the margins. Extending almost around the ventral side of the body is a broad zone containing many tubular ducts which have the inner ex-

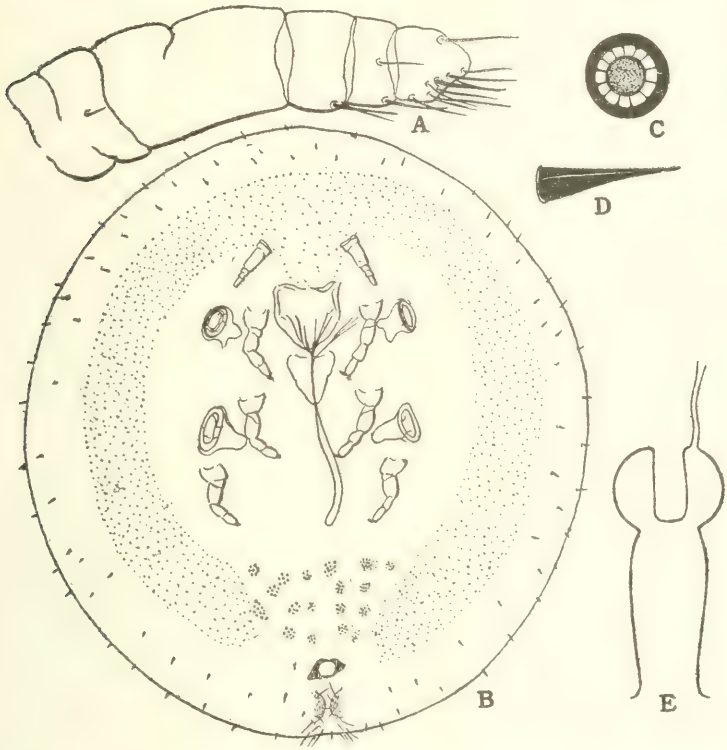


Fig. 10.—*Kermes cockerelli* Ehrh.; *A*, antenna of adult female; *B*, adult female before the hardening of the derm; *C*, pore from ventral cluster; *D*, dorsal spine; *E*, wax duct. From specimen from topotype material.

tremity reflexed into a very deep and narrow cup (Fig. 10*E*). Behind the posterior legs are numerous clusters of circular, multilocular pores of the type shown in Fig. 10*C*.

In the penultimate stage (Fig. 11*B*) the body is oval in form and shows small anal lobes. The lateral margins are beset with numerous slender spines. The antennæ (Fig. 11*D*) are 6-segmented as in the adult but much slenderer. Anal ring with six setæ. Tubular ducts lacking.

First stage larva (Fig. 11*A*), with the anal lobes well developed and rather heavily chitinized. Margin of the body with a single row of slender

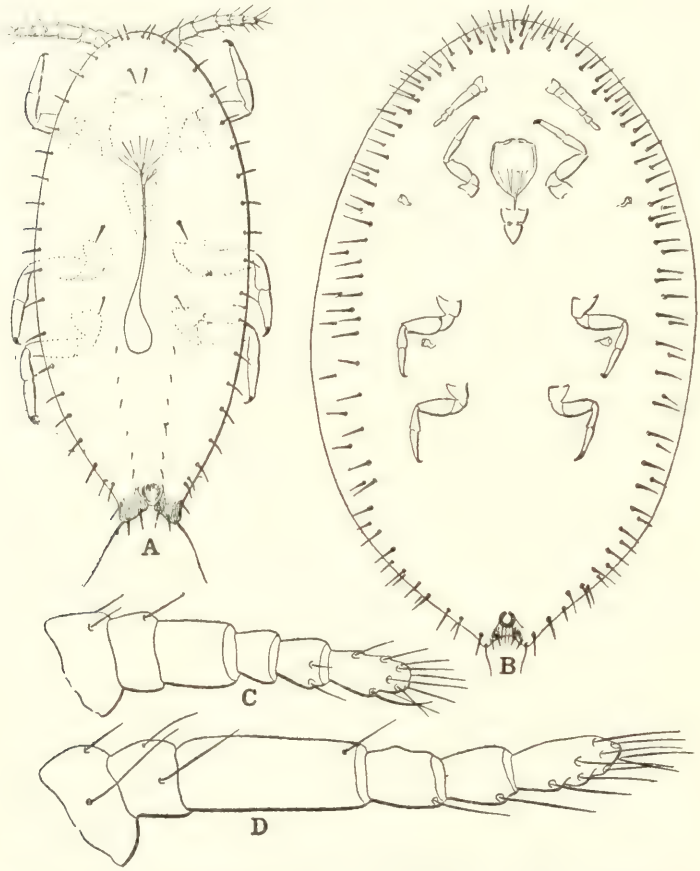


Fig. 11.—*Kermes cockerelli* Ehrh.: *A*, first stage larva; *B*, second stage; *C*, antenna of first stage; *D*, antenna of second stage. From specimens from topotype material.

spines. Antennæ (Fig. 11*C*) 6-segmented, of the same type as in the other stages. Dorsum without spines except for a pair of very small spines on each abdominal segment and two or three pairs of larger spines on the cephalothorax.

### **Kermes nigropunctatus** Ehrh.

Figs. 9*B* and 12.

Within this area this species has been taken from *Quercus agrifolia* and *Q. wislizeni.*

*Habit.* Adult entirely destitute of secretionary covering. The color is extremely variable, some specimens being very dark and others quite pale, this variation depending in part upon actual variability, in part upon the amount of weathering undergone before collection and in part upon the age of the insect at the time of death. In all specimens, however, there is a pair of black, eye-like spots at the anterior end of the body, a character that seems effectually to mark the species.

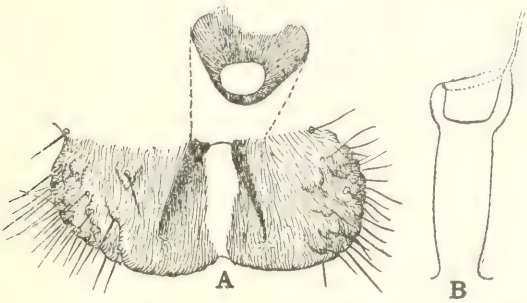


Fig. 12.—*Kermes nigropunctatus* Ehrh.: *A*, anal lobes and anal ring of adult female; *B*, wax duct. From specimen from *Quercus wislizeni*, on the Santa Cruz Peninsula.

In form (Fig. 9*B*) the adult somewhat resembles *K. cockerelli*, but the intersegmental constrictions are much shallower and the insect is only slightly gibbous.

*Morphological characteristics.* In specimens in the last instar, but taken before the chitinization of the derm has begun, the anal lobes (Fig. 12*A*) appear as a pair of heavily chitinized, wart-like prominences, each of which bears many slender setæ. The anal ring is borne at the inner end of a short invagination, is heavily chitinized, somewhat funnel-shaped, and bears no setæ. The dorsum bears a few stout, sharply pointed spines. The tubular ducts are few and small, of the form shown in Fig. 12*B* and are scattered over the body, not being arranged in a ventral zone as in *K. cockerelli.* The groups of circular pores found on the venter of the latter species are lacking in *K. nigropunctatus.* Antennæ and legs as in *cockerelli.*

Immature stages not seen.

Notes: I consider *Kermes essigi* King to be identical with *K. nigropunctatus.* I have at hand specimens from what is possibly the type lot of the former species and am unable to detect any differences between the two. In this opinion Mr. Ehrhorn concurs. Furthermore if certain specimens at hand purporting to be *K. branagani* King are correctly determined this species too is a synonym of *nigropunctatus.*

### **Kermes rattani** Ehrh.

Fig. 9*A*.

Originally described from *Quercus chrysolepis* in this locality.

I have been able to obtain only fully mature individuals of this species and can say nothing as to its morphology. In appearance the species presents a wide range of variation both in form and coloring. The typical form is practically spherical, but various distortions arise because of unfavorable position.

Judging from the figure of *Kermes mirabilis* King and from the fact that its type locality is the same as that of *K. rattani* this species may quite safely be regarded as identical with *K. rattani.* Mr. Ehrhorn concurs in this opinion also.

## Genus **PSEUDOCOCCUS** Westwood.

In an earlier paper [1] I have dealt at some length with this and related genera. More material is now available than at the time when this paper was published, and certain conclusions there expressed require modification. In addition certain errors, both of observation and judgment, may be corrected.

In this earlier paper the genera *Phenacoccus* and *Pseudococcus* were in part separated by ascribing eighteen pairs of cerarii to the former genus and seventeen to the latter. A re-examination of my material indicates a serious error in observation. In *Pseudococcus citri* and *P. kraunhiae* there are in fact eighteen pairs, although *P. longispinus* and some other species have but seventeen. This character, therefore, cannot be relied upon for the separation of these genera. Neither may the number of antennal segments be considered as decisive, since there are some species, notably *Phenacoccus solani* Ferris, in which the antennæ may be either eight- or nine-segmented. Nor is the single remaining character, that of the presence of a denticle on the claw in *Phenacoccus,* entirely satisfactory, as this denticle is at times so extremely small as practically to be obsolete.

I am by no means prepared to concede that these two genera should be united, for their types are certainly sufficiently different, and it is probable that a large majority of species may be placed satisfactorily. Neither am I prepared to say just where the division between the two genera should come. This particular difficulty is but one of a series of difficulties that arise in dealing with this group, as I have elsewhere pointed out.[2] The difficulties may not be disposed of without the examination of a much larger series of forms than have yet been studied.

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[1] "The California Species of Mealy Bugs." Stanford University Publications, University Series. 1915.

[2] "Contribution to the Knowledge of the Coccidae of Southwestern United States," p. 31. Stanford University Publications, University Series. 1919.

**Pseudococcus aurilanatus** (Maskell).

An introduced species, reported from within this area only on *Araucaria excelsa* at Mountain View.

**Pseudococcus gahani** Green.

1919. *Pseudococcus gahani* Green; Ferris, *Jn. Ec. Ent.* **12**:292.

This is an introduced species, known from this area only from Hillsborough and San Francisco. It infests a wide range of hosts.

I have elsewhere (ref. cited) pointed out that this is the proper name for the species that has passed under the name of *Pseudococcus citrophilus* Clausen.

**Pseudococcus crawii** (Coq.).

Within this area this species has been taken only from *Quercus chrysolepis* and *Pasania densiflora.*

**Pseudococcus eriogoni** (Ehrh.).

Originally described from *Eriogonum* sp. in this area. It occurs commonly on this and several other hosts.

**Pseudococcus longisetosus** Ferris.

Described from this area. It has been taken from the roots of *Orobanche tuberosa* and *Castilleia foliolosa.*

**Pseudococcus maritimus** Ehrh.

Originally described from *Eriogonum latifolium* at Santa Cruz. It occurs throughout the area on a wide range of wild and cultivated hosts.

**Pseudococcus quercus** Ehrh.

1919. *Pseudococcus quercus* Ehrh.; Ferris, *Jn. Ec. Ent.* **12**:298.

Originally described from this area where it occurs quite commonly on *Quercus chrysolepis* and *Pasania densiflora.*

I have elsewhere (ref. cited) explained the reasons for the resurrection of this name and the dropping of *Pseudococcus quercicolus* Ferris.

**Pseudococcus ryani** (Coq.).

Occurring within this area only on *Sequoia sempervirens.*

**Pseudococcus salinus** (Ckll.).

A native species, found only on the salt marsh grass, *Distichlis spicata,* in the marshes about San Francisco Bay.

### **Pseudococcus sequoiæ** (Coleman).

Originally described from this area, where it is common on *Sequoia sempervirens* and is at times a pest on *Cupressus macrocarpa.*

### **Pseudococcus timberlakei** Ckll.

Originally described from this area, where it is found only on the salt marsh grass, *Distichlis spicata,* about San Francisco Bay.

## Genus **PHENACOCCUS** Ckll.

### **Phenacoccus colemani** Ehrh.

Originally described from this area on *Rubus* sp. It is a rather common species, infesting various hosts among which are *Rubus vitifolius,* wild strawberry, *Symphoricarpos racemosus, Castilleia* sp. and *Eriophyllum confertiflorum.*

### **Phenacoccus eriogoni** Ferris.

Originally described from this area on *Eriogonum nudum.*

This species is extremely close to *P. helianthi* (Ckll.). It differs from the latter only in having a small, median cluster of spines on the dorsum of the last abdominal segment and in having six to eight spines in the lateral cerarii, while *helianthi* has in general but two.

### **Phenacoccus solani** Ferris.

Originally described from this locality on the roots of *Hemizonia rudis.* It has also been taken from the roots or crowns of potato, tomato, wild radish and *Malva* sp.

I have recently received specimens of this species from the crowns of "ragweed," *Ambrosia* sp., at Gainesville, Florida. In these specimens the antennæ may be either eight- or nine-segmented.

This species so combines the characters of *Phenacoccus* and *Pseudococcus* that it might with equal propriety be referred to either genus. I am inclined to retain it in *Phenacoccus.*

### **Phenacoccus stachyos** Ehrh.

Originally described from this area on *Stachys* sp. I have taken it from several other hosts, including *Rhus diversiloba, Monardella* sp., *Diplacus glutinosus* and *Solanum* sp.

Genus **PUTO** Sign.

**Puto cupressi** (Coleman).

A native species, occurring in this area on *Sequoia sempervirens* and *Torreya californica.*

**Puto ambigua** (Fullaway).

A native species, originally described from this area, where it is known only from the "pickleweed," *Salicornia ambigua,* in the salt marshes about San Francisco Bay.

**Puto yuccæ** (Coq.)

A native species which occurs quite commonly in this area on *Eriophyllum confertiflorum.* It has also been taken from *Garrya elliptica, Diplacus glutinosus* and *Stachys* sp.

Genus **ERIUM** Ckll.

**Erium lichtensioides** Ckll.

A native species, occurring sparingly on sage brush, *Artemisia californica.*

Genus **TRIONYMUS** Berg.

**Trionymus bromi** Ferris.

A presumably native species, originally described from this area on *Bromus* sp. It has also been taken from *Ammophila arenaria* (an introduced grass) on the sand dunes at San Francisco.

**Trionymus californicus** Ehrh.

A native species which is rather common on various species of *Elymus.*

**Trionymus distichlii** Ferris.

A native species, originally described from this area, where it is known only from the salt marsh grass, *Distichlis spicata,* in the salt marshes about San Francisco Bay and along the coast.

**Trionymus festucæ** (Kuwana).

A native species, originally described from this area on *Festuca* sp. In my paper on the California species of this group I have included with this species a *Trionymus* that occurs on bamboo on the Stanford Campus. I am now inclined to believe that the two are not identical.

### **Trionymus smithii** (Essig).

From undetermined grass near Stanford University and *Elymus* sp. near San Jose.

### **Trionymus villosa** (Ehrh.).

I have not myself taken this species in this area, but there are specimens in the Stanford collection from *Quercus agrifolia* near Mountain View.

### **Trionymus** sp.

An undetermined *Trionymus* on bamboo on the Stanford campus. I have previously included this with *T. festucae* but now regard it as distinct. It is doubtless introduced.

## Genus **ACLERDA** Sign.

### **Aclerda californica** Ehrh.

Fig. 13.

Originally described from this area, where it occurs quite commonly on a particular, unidentified species of grass that grows in the chaparral

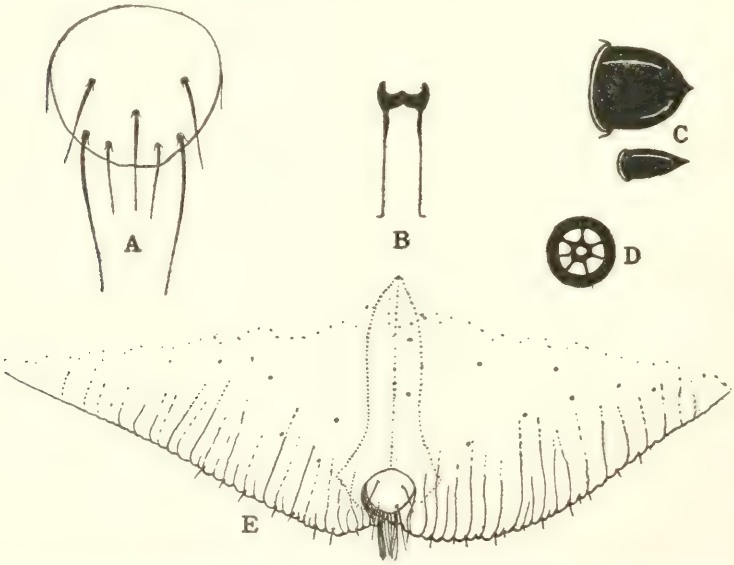


Fig. 13.—*Aclerda californica* (Ehrh.) : *A*, anal plate; *B*, wax duct; *C*, types of marginal spines; *D*, pore; *E*, dorsal aspect of posterior extremity of abdomen of adult female. From specimen from topotype material.

on dry hillsides. The insects are ordinarily found at the bases of the stems. Parrott has recorded the species from Kansas, but has noted certain differences between the specimens from the two regions. It is quite possible that he was dealing with a different form.

The general appearance of the adult female has been well described by Ehrhorn and Parrott, but there remain certain important details of structure that have been overlooked.

In the adult female the posterior end of the body (Fig. 13*E*) is heavily chitinized, although this area is not definitely delimited as in *A. ariditatis* Ferris, the margin is crenulate and both dorsum and venter show numerous shallow furrows. The margins of this chitinized portion are beset with small, slender spines. Beginning at the anterior margin of this area is an irregularly single or double row of short, stout, acorn-shaped spines (Fig. 13*C*), that extends entirely around the anterior portion of the body. These spines are of various sizes, but all are of the same characteristic shape, broad and short, very slightly or not at all constricted at the base and with the apex produced into a sharp point. Just within this series of spines lies a zone of rather conspicuous, multilocular pores (Fig. 13*D*), this zone disappearing on the head and widening opposite the spiracles. Within this zone are a few slender spines, and distributed irregularly over the body are a few tubular ducts of the type shown in Fig. 13*B*.

The anal plate (Fig. 13*A*) is not emarginate at the tip. It bears several setæ. The anal ring lies immediately beneath this plate (not anteriorly to it as in some species). The edges of the ventral furrow, which is continuous with the anal cleft, are contiguous and heavily chitinized.

### **Aclerda tokionis** Ckll.

Fig. 14.

This is an introduced species, probably a native of Japan, which has once been taken from bamboo on the Stanford campus. Specimens from this material agree entirely with specimens from Japan.

This species differs in certain conspicuous details from the preceding. The marginal spines (Fig. 14*B*) are smaller and quite differently shaped, being blunt-tipped and definitely constricted toward the base. The marginal series of these spines extends almost to the margins of the anal cleft. The zone of multilocular pores seen in *A. californica* is lacking, being replaced by a similarly situated zone of small, straight tubular ducts which are mingled with a few large ducts of the type shown in Fig. 13*B* and a few small spines. The anal plate (Fig. 14*C*) is distinctly

emarginate at the tip. The anal ring lies directly beneath the anal plate. The ventral furrow is open, its margins diverging anteriorly and not heavily chitinized.

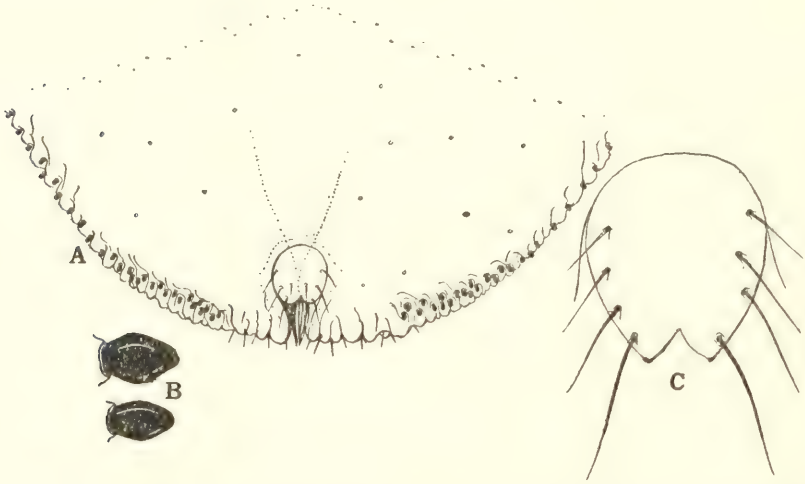


Fig. 14.—*Aclerda tokionis* (Ckll.): *A*, dorsal aspect of posterior extremity of abdomen of adult female; *B*, marginal spines; *C*, anal plate. From California material.

## Genus **PULVINARIA** Targ.

### **Pulvinaria ehrhorni** King.

Originally described from this area, from alder and willow. It is apparently rather rare, as I have obtained but a single specimen in five years of collecting. Presumably native.

The single specimen available shows some indications of abnormality and is hardly suitable material upon which to base a re-description. I may note, however, that while the species in life resembles *P. vitis* it is evidently distinct, as the marginal spines are filiform. In this respect it somewhat resembles *P. rhois*, differing however, from the latter in having the derm of the dorsum heavily chitinized instead of membranous. In certain respects it appears to resemble *P. amygdali* Ckll.

### **Pulvinaria rhois** Ehrh.

Fig. 15.

Described from this area. As far as known it occurs only on the "poison oak," *Rhus diversiloba*. I have seen specimens taken from this host at Walnut Creek, Contra Costa County, California. The species is

very sporadic in its occurrence. The poison oak is one of our most abundant shrubs, yet I have met with the scale but twice, each time on isolated bushes and here in abundance. It is presumably native.

In all of the specimens examined the derm of the fully mature female is entirely membranous. The marginal spines (Fig. 15*B*) are slender

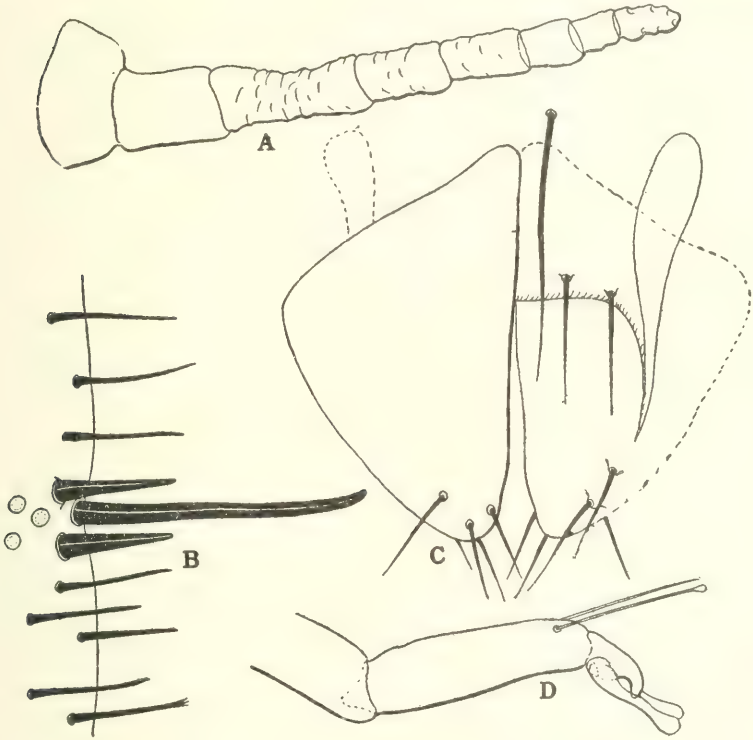


Fig. 15.—*Pulvinaria rhois* Ehrh.: *A*, antenna; *B*, marginal spines in the region of a stigmatic depression; *C*, anal plates, dorsal aspect left, ventral aspect right; *D*, tarsus and portion of tibia. From specimen from topotype material.

and quite long and are arranged in an irregularly single or double series. The stigmatic spines are large and conspicuous, the median spine being nearly three times as long as the others. Anal plates (Fig. 15*C*) quite large and broad, each with three or four apical setæ on the dorsal side and two subapical setæ on the ventral side. Antennæ (Fig. 15*A*) normally 8-segmented. Legs rather stout, the claw (Fig. 15*D*) with very broad digitules.

**Pulvinaria vitis** (Linnæus).

I have once taken this species from maples on the Stanford campus. It is probably more or less distributed throughout this area, but is certainly not abundant.

Genus **SAISSETIA** Deplanches.[3]

**Saissetia oleæ** (Bern.).

Abundant upon a wide range of hosts. Among the wild plants that it especially favors are mistletoe and *Baccharis pilularis*. It has also been taken from *Grindelia cuneifolia, Solanum* sp. and *Ceanothus* sp.

**Saissetia nigra** (Nietn.).

This has been taken on *Euonymus* sp. on the Stanford campus.

Genus **COCCUS** Linn.

**Coccus hesperidum** Linn.

A very common species on a wide range of wild and cultivated hosts.

**Coccus citricola** Campbell.

Said to occur at San Francisco. I have not seen specimens.

Genus **LECANIUM** Burm.

**Lecanium corni** (Bouché).

What appears to be entirely typical *L. corni* is abundant here on mulberry, apricot, prune, and other cultivated hosts. What is supposed to be this species has been taken from a long series of wild hosts, including *Alnus rhombifolia, Adenostoma fasciculatum, Arbutus menziesii, Ceanothus* sp., *Acer macrophyllum* and *Heteromeles arbutifolia*. From the two last named hosts it has been described as new under the names of *L. crawii* Ehrh. and *L. adenostomæ* Kuwana.

There is a very considerable diversity in appearance among specimens from these various hosts, ranging from a large, pruinose form on elm to a very small and shiny form on *Arbutus*, but there appear to be no structural differences. Whether all these forms belong to a single species can only be determined by extensive transference experiments.

[3] There is no evidence that *S. hemisphaerica* occurs out of doors in this area, although I have seen some of the small and shiny forms of *Lecanium corni* identified as this species.

### Lecanium cerasorum Ckll.

1915. *Lecanium cerasorum* Ckll.; Essig, "Injurious and Beneficial Insects of California," ed. 2, p. 145, fig. 124.

This is an introducd species that is now established in the vicinity of San Jose, where it occurs on fruit trees.

Structurally this appears to be inseparable from *L. excrescens* n. sp., which is described below, but the two differ greatly in appearance. As maturity approaches *L. excrescens* becomes covered with a thick coating of loose, white secretion, while *L. cerasorum* remains naked throughout. It is a very conspicuous object, the dorsum being marked with a series of regularly arranged white spots (well shown in the figure given by Essig), from which it has derived the popular name "calico scale."

There is nothing in the original description of this species that will permit its identification, and there is a possibility that the species here recorded as *cerasorum* is incorrectly determined.

### Lecanium pruinosum (Coq.).

What is supposed to be this species is rather common on walnut.

### Lecanium pubescens Ehrh.

Under this name there has been described from this region a form which occurs quite commonly on *Quercus agrifolia* and on *Aesculus californicus*. It differs from typical *L. corni* only in its somewhat larger size, the presence of rather evident, transverse dark bands in life and a slight amount of loose secretion (the "very soft hair" of the original description). Structurally it does not differ from *L. corni*.

### Lecanium excrescens n. sp.

Fig. 16.

*Type host and locality.* From cultivated English walnut, Palo Alto, Calif. It occurs in this vicinity on almond and maple also.

*Habit.* A very large species, attaining a height of 8–10 mm. and a diameter of 10 mm. in the largest examples. In form the fully developed scales are very high convex (Fig. 16*A*), with the margin nearly perpendicular to the base, which is nearly circular in outline. During the last instar the scale becomes entirely covered with a thick coating of rather fluffy, white secretionary matter which disappears in weathered individuals, the latter being very dark brown and slightly shiny.

In the second and early third stages the dorsum is entirely destitute of secretion except for a number of symmetrically and characteristically

arranged lumps of pure white wax. (No examples of these stages are available for figuring.) Beneath these lumps the derm, elsewhere dark brown, is distinctly yellow.

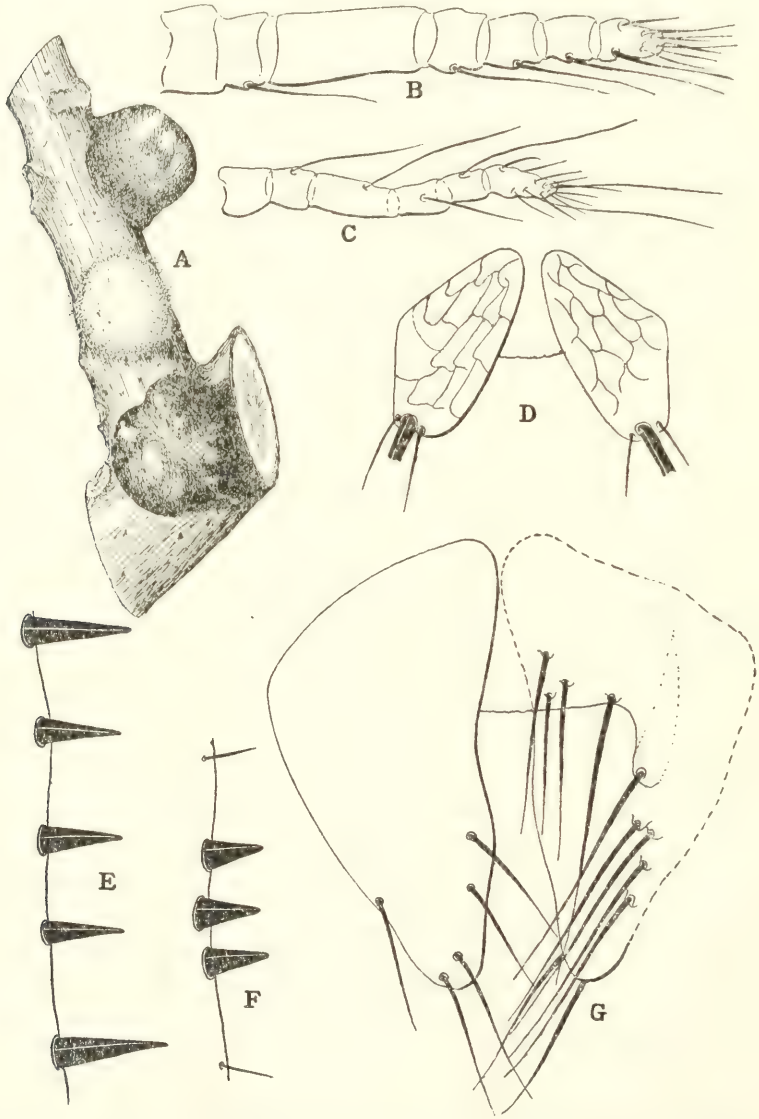


Fig. 16.—*Lecanium excrescens* n. sp.: *A*, habit; *B*, antenna of adult female; *C*, antenna of first stage; *D*, anal plates of first stage; *E*, marginal spines of adult at region of a stigmatic depression; *F*, marginal spines of first stage at region of stigmatic depression; *G*, anal plates of adult, dorsal aspect left, ventral aspect right.

*Morphological characteristics.* Marginal spines (Fig. 16*E*) arranged in a very definite single row, quite large and sharply conical, their distance apart depending upon the size of the insect. In specimens taken before the beginning of the period of rapid growth the spines are separated by intervals scarcely greater than the width of the base of a single spine. Stigmatic spines scarcely or not at all differentiated, the stigmatic clefts practically obsolete. Anal plates (Fig. 16*G*) very large, rather long and narrow, with a varying number of setæ near the apex, with as many as five subapical setæ on the ventral side and with as many as ten fringe setæ. Antennæ (Fig. 16*B*) rather short, normally 7-segmented, the third segment conspicuously longer than any of the others. Legs small, not stout, the claw with two slender digitules. Pores of the dorsum abundant, small, not arranged in any definite manner.

Second stage not available for description.

First stage with three small stigmatic spines (Fig. 16*F*) in each stigmatic depression and with marginal spines represented by a few slender setæ. Anal plates (Fig. 16*D*) of the form usual in the genus, but with their dorsum presenting a tessellated appearance. Antennæ (Fig. 16*C*) 6-segmented.

Notes: The holotype is a mount of a specimen in the last instar but not fully grown and with the derm still membranous.

This species is one of a group to which belong *L. caryae* (Fitch) of the eastern states and another species (certainly introduced) which occurs in California and passes as *L. cerasorum* Ckll. From the former it differs in its much more convex form and in having more hairs on the anal lobes. From the latter it does not differ at all structurally, but this species remains destitute of secretion at maturity and in life is so conspicuously marked with large white spots that it has been called the "calico scale." Judging from the description of that species, *L. glandi* Kuwana is very similar in appearance but differs in having the marginal spines slender.

## Genus **PHYSOKERMES** Targ.

The existing descriptions of this genus make no mention of its most important character and in certain respects require modification. I present the following diagnosis.

Coccidæ referable to the subfamily Coccinæ, characterized, as are the other members of this subfamily, by the presence of a pair of triangular, supra-anal plates in the first and second instars, but differing from all other members of this group by the absence of these plates in the last instar, the plates being replaced at the second molt by a single median lobe. Marginal spines lacking in the adult, the stigmatic depressions not indicated. Antennæ and legs either present or absent in the adult female.

Body form globular, the venter being deeply intussuscepted and forming a marsupium for the retention of the eggs. Infesting, as far as known, only coniferous hosts.

Notes: The loss of the anal plates at the final ecdysis appears to have been overlooked by earlier writers, only a single author[4] having noted the fact and this without comment. The absence of these plates has been established only in *P. piceae* (the type of the genus) and *P. insignicola,* but it may safely be assumed that the remaining species of the genus are similar.

### **Physokermes insignicola** (Craw).

Fig. 17.

Originally described from this area where it is something of a pest on the Monterey Pine (*Pinus radiata*).

This species has been the subject of an extensive paper by Moulton in which, unfortunately, its morphology has been but inadequately dealt with. I append the following notes.

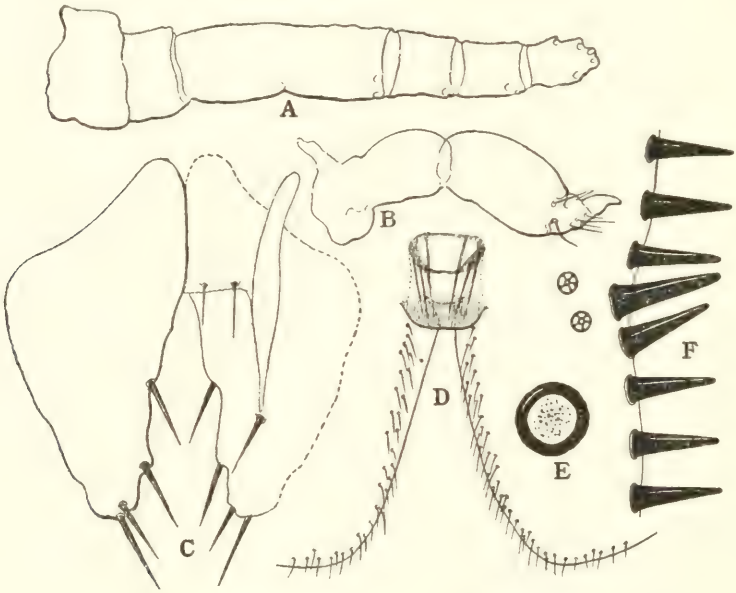


Fig. 17.—*Physokermes insignicola* (Craw): *A,* antenna of adult female; *B,* leg of adult female; *C,* anal plates of second stage; *D,* anal region of adult; *E,* dorsal pore; *F,* marginal spines from region of stigmatic depression of second stage female.

*Adult female,* taken before the chitinization of the derm has set in. Legs and antennæ present, the former (Fig. 17*B*) very short and stout,

[4] Fenton, F. A., *Can. Ent.,* **49**:320. (1917)

more or less misshapen and with the tarsus much reduced, the latter (Fig. 17*A*) well formed and large, 6-segmented, with the third segment very long. Stigmatic depressions not indicated, the stigmatic spines lacking. Marginal spines lacking except along the margins of the anal cleft (Fig. 17*D*), where there are numerous slender setæ. Anal ring practically simple, bearing six short setæ. Dorsum beset with small, circular pores with a chitinized rim (Fig. 17*E*), which are especially numerous over the posterior half. In fully mature individuals the derm becomes extremely heavily chitinized, and it is practically impossible to obtain preparations in which these various structures can be seen.

*Second stage* with the antennæ practically as in the adult but slightly more slender. Legs well formed, large and slender. Marginal spines (Fig. 17*F*) quite large, slender, conical, set in a sharply defined single row, the spines being separated from each other by a distance of scarcely more than the width of their bases. Stigmatic depressions scarcely noticeable, the stigmatic spines but little or not at all larger than the other marginal spines. Anal plates (Fig. 17*C*) rather slender, each with three apical spines and a single spine on the mesal margin and a single subapical spine on the ventral side. There are four very small fringe setæ.

First stage not seen.

### **Physokermes taxifoliæ** Coleman.

Originally described from this area, where it occurs rather sparingly on the Douglas spruce, *Pseudotsuga taxifolia*. I have been unable to obtain suitable specimens for microscopic examination.

## Genus **TOUMEYELLA** Ckll.

### **Toumeyella pinicola** n. sp.

Fig. 18.

*Type host and locality.* From *Pinus radiata* on the grounds of the Spring Valley Water Company at Aqua, San Mateo County, Calif.

*Habit.* Occurring on the small twigs at the bases of the needles. Entirely destitute of secretion; dried specimens much wrinkled, more or less irregular in form because of crowding, somewhat straw colored except for a small brown area about the anal plates. Length about 3 mm.

*Morphological characteristics.* Derm entirely membranous except for a heavily chitinized, circular area about the anal plates. Marginal spines very few, small and slender. Stigmatic spines (Fig. 18*E*) short and stout, somewhat spindle shaped, the middle spine not longer than the others. Stigmatic depressions shallow, marked by a broad zone of circular pores which extends in to the corresponding spiracle. Anal plates (Fig. 18*B*) large, the cephalic margin distinctly longer than the caudal

margin. Each plate with several apical and subapical setæ on the dorsal side and two or three subapical setæ on the ventral side. There is a single very long fringe seta at each side and there are numerous hypopy-

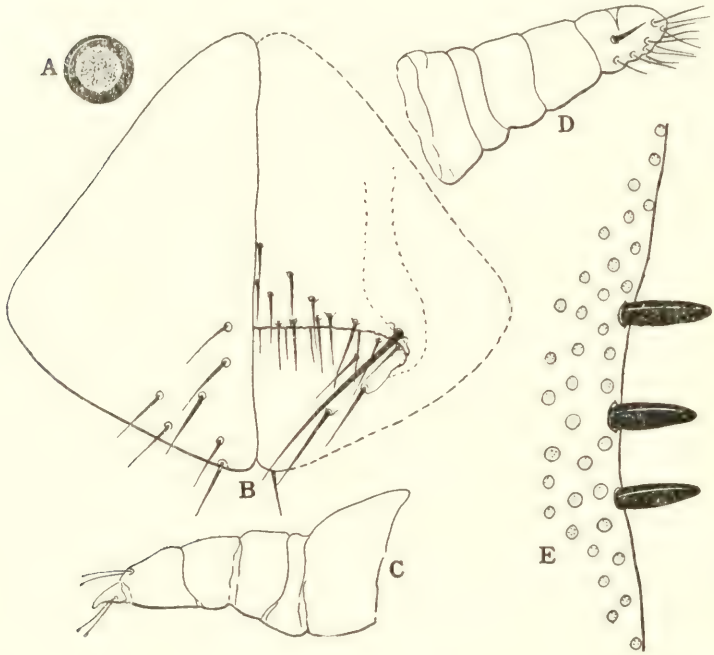


Fig. 18.—*Toumeyella pinicola* n. sp.: *A*, dorsal pore; *B*, anal plates, dorsal aspect left, ventral aspect right; *C*, leg of adult; *D*, antenna of adult; *E*, stigmatic spines of adult.

gial setæ. Anterior to the anal plates are numbers of the conspicuous pores (Fig. 18*A*), which are rather characteristic of the genus, the majority of these pores lying within the chitinized area. Legs (Fig. 18*C*) and antennæ (Fig. 18*D*) small and stout, the latter obscurely 6-segmented.

Immature stages not observed.

Notes: I have at hand specimens of a *Toumeyella* from pine in Florida which probably represent *T. parvicorne* (Ckll.) and which differ from the new species in having the cephalic and caudal margins of the anal plates equal and the median stigmatic spine longer than the others. As *T. pini* King is probably a synonym of *T. parvicorne* the new species may not be referred to *pini*.

It is almost certain that this is an introduced species as it has never been found upon the Monterey Pine in its native habitat.

## Genus **CHIONASPIS** Sign.

This genus has been greatly restricted by Cooley, and in all probability justly so, but no provision has been made for the species that have been excluded from it. Therefore, while accepting this restriction I am still retaining in the genus such forms as *C. spartinæ* Comst. and *C. quercus* Comst., not caring at present to undertake the responsibility of defining new genera for them, however different they may be from the type of *Chionaspis.*

### **Chionaspis quercus** Comst.

Fig. 19.

Common on the various species of *Quercus* and also on the tan oak, *Pasania densiflora.*

Of this species there are none but the rather crude figures accompanying the original description and a later note by Essig. I present a

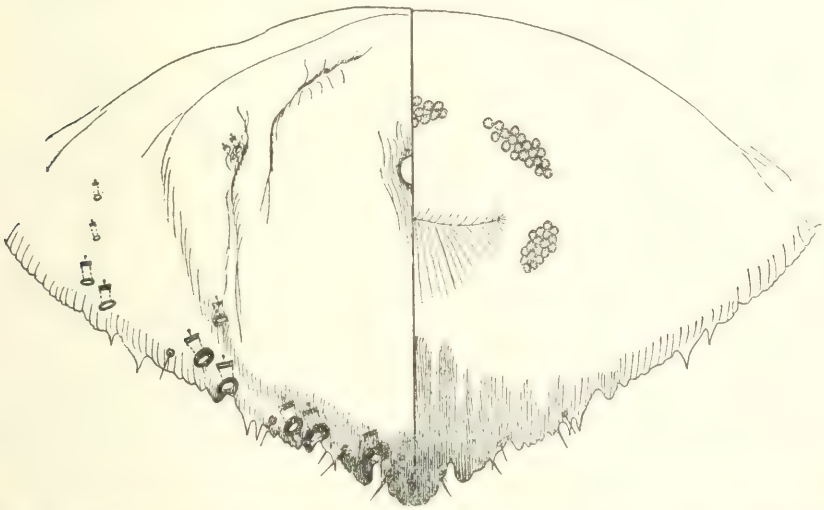

Fig. 19.—*Chionaspis quercus* Comst.: pygidium of specimen from *Quercus agrifolia.*

new figure. The original description is quite accurate, but I may note that the dorsum of the abdomen is almost destitute of ducts and that there are a few ducts and gland spines at the margins of each abdominal segment.

### **Chionaspis pinifoliæ** (Fitch).

Abundant upon the numerous species of pines grown here as ornamentals. Also on *Pseudotsuga taxifolia* and *Torreya californica.* It is probably to be regarded as native.

### **Chionaspis spartinæ** Comst.

Fig. 20.

Found, in this area, only on a salt marsh grass, *Spartina stricta,* about San Francisco Bay.

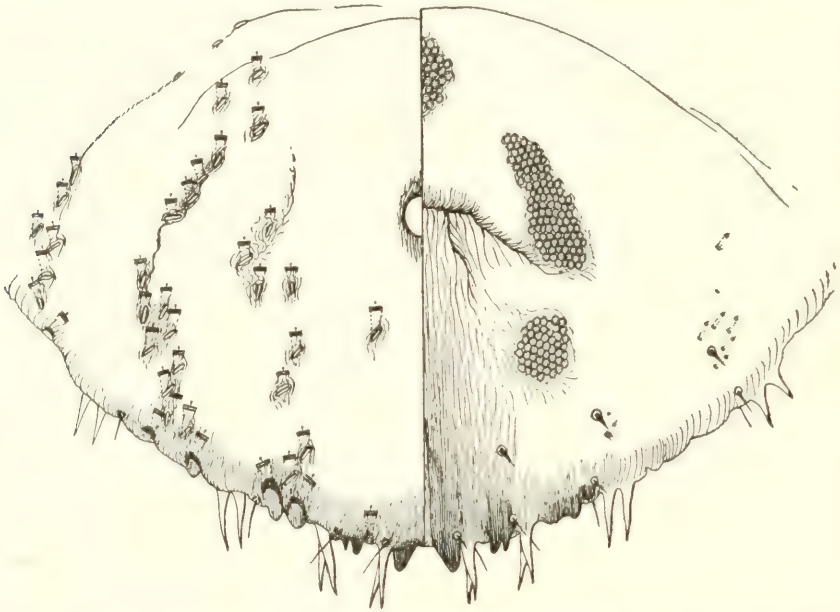

Fig. 20.—*Chionaspis spartinæ* Comst.: pygidium of specimen from California material.

I present a new figure of the pygidium. The dorsum of the abdomen is practically destitute of ducts, but there are numerous small ducts at the lateral margins and there is a more or less well-defined row of large ducts anterior to those shown in the figure. There are no gland spines anterior to the pygidium.

## Genus **DIASPIS** Costa.

With this genus I am uniting *Epidiaspis* Ckll. In characterizing *Epidiaspis* originally as a subgenus of *Diaspis,* Cockerell has stated that *D. piricola* (the type of the former genus) "has the club-shaped glands at the bases of the lobes, as in *Diaspidiotus,* and I think that it is related thereto rather than to *Diaspis.*" As a matter of fact, these "club-shaped glands," which are not glands at all, but merely chitinous thickenings, are morphologically very different from the thickenings seen in *Aspidiotus.* In the latter genus these thickenings bound the margins of the poriferous furrows, while in *D. piricola* they are the much enlarged thickenings that

are always present in some degree of development about the bases of the marginal spines. In all other respects *D. piricola* is a perfectly typical species of *Diaspis*. As far as the unusual development of these thickenings is concerned the species is connected with typical *Diaspis* by such a form as *D. montana* Ckll., in which there is an obvious tendency in the same direction.

Certain other species that have been ascribed to *Epidiaspis* should probably likewise be referred to *Diaspis*.

**Diaspis carueli** Targ.

Very abundant on *Libocedrus decurrens, Thuya* sp. and various species of *Cupressus* on the Stanford campus and doubtless elsewhere. An introduced species.

**Diaspis echinocacti** (Bouché).

On various species of cacti on the Stanford University campus. An introduced species.

**Diaspis manzanitæ** (Whitney).

Fig. 21.

I have found this species in but a single restricted locality, near Summit Rock, above Saratoga, at an altitude of approximately 3000 feet, where it occurs on the leaves of some species of *Arctostaphylos*.

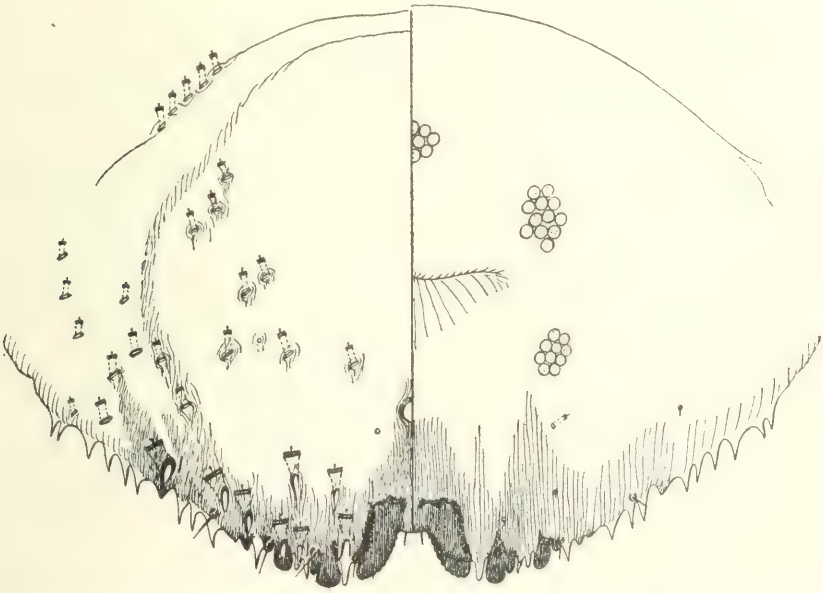

Fig. 21.—*Diaspis manzanitæ* (Whitney): pygidium of specimen from Santa Cruz Peninsula.

This was originally described as an *Aulacaspis,* but by reason of the scattered dorsal pores of the pygidium it is distinctly a *Diaspis.* The accompanying figure will supplement the original description.

**Diaspis piricola** (Del Guer.).

Fig. 22.

Common on pear and prune. The only native host that it is known to attack is the Christmas berry, *Heteromeles arbutifolia,* upon which it becomes extremely abundant.

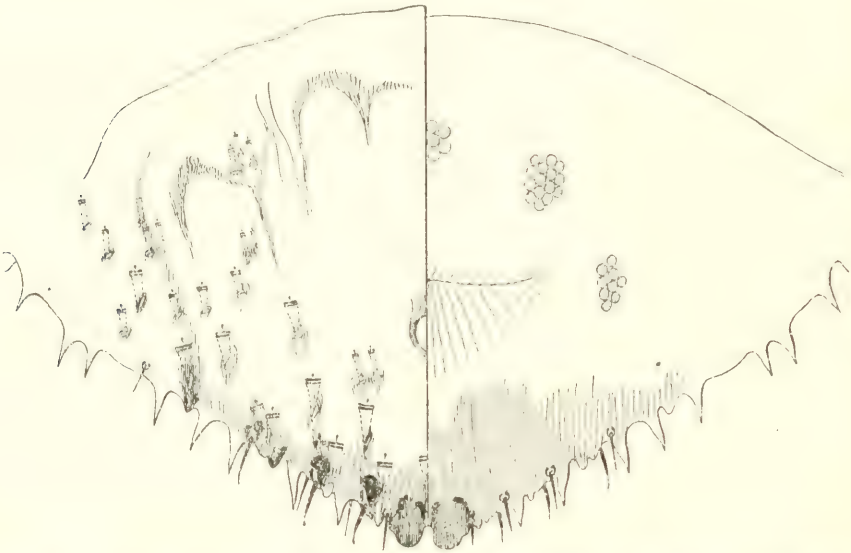

Fig. 22.—*Diaspis piricola* (Del Guer.): pygidium of specimen from prune on the Santa Cruz Peninsula.

I have pointed out in the discussion of the genus *Diaspis* the grounds for rejecting *Epidiaspis* and restoring this species to the former genus. The only figures of *D. piricola* that I have seen are inadequate or even quite misleading, and I present a new figure of the pygidium.

Genus **AULACASPIS** Ckll.

**Aulacaspis rosæ** (Bouché).

Rather common on roses, cultivated blackberries and raspberries.

Genus **DINASPIS** Leonardi.

I have not been able to see the original description of this genus and am referring one species, *Leucaspis kelloggi* Coleman, to it upon the suggestion of Mr. E. E. Green.

**Dinaspis kelloggi** (Coleman).

Fig. 23.

A native species, originally described from this area, where it occurs rather commonly on the Douglas Spruce, *Pseudotsuga taxifolia* and occasionally on pine.

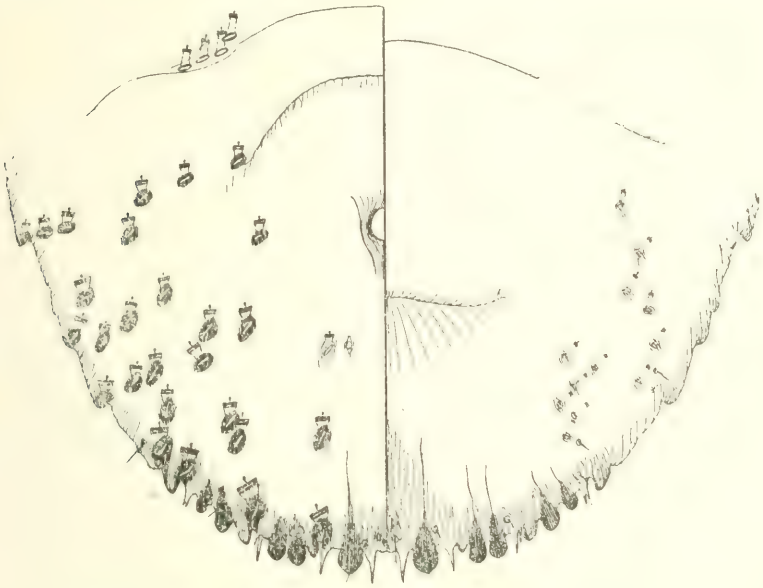

Fig. 23.—*Dinaspis kelloggi* (Coleman): pygidium of specimen from *Pseudotsuga taxifolia* on the Santa Cruz Peninsula.

The original description of the species is quite accurate, but the figure of the pygidium leaves much to be desired and I present a new figure. The species is certainly not a *Leucaspis*.

## Genus **LEPIDOSAPHES** Shimer.[5]

**Lepidosaphes newsteadi** (Sulc).

Recorded by Coleman from *Sciadopitys*, near Stanford University.

**Lepidosaphes ulmi** (Linn.).

A common species on willow and apple. I have also taken it from passion flower and from a native host, *Xylothermia* (or *Pickeringia*) *montana*.

[5] It is probable that *L. ceanothi* Ferris occurs in this area, as scales almost certainly of this species have been seen upon *Ceanothus*. However, no specimens are available and the record can not be definitely established.

## Genus **ASPIDIOTUS** Bouché.

### **Aspidiotus aesculi** Johns.

Fig. 24.

Originally described from this locality, where it is frequently abundant on *Aesculus californicus*. It is usually associated with a pitting and roughening of the bark, for which it is perhaps responsible.

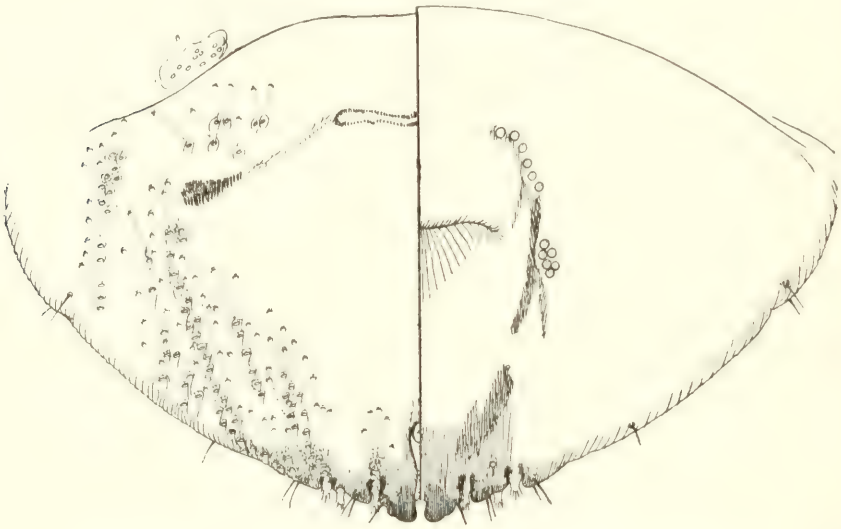

Fig. 24.—*Aspidiotus æsculi* Johns.: pygidium of topotype specimen.

I have at hand specimens from box elder (*Acer negundo*) and poplar at Salt Lake City, Utah, and from poplar near Lone Pine, Inyo County, Calif., which I refer to this species. As all these specimens agree also with the description and figure of *A. popularum* Marlatt, which was described from poplar in New Mexico, I place the latter species as a synonym of *æsculi*.

### **Aspidiotus arctostaphyli** Ckll. and Rob.

Fig. 25.

What appears to be this species has been taken from *Arctostaphylos* sp. near Los Gatos. The specimens are immature, and the determination is not entirely certain, but the record may be accepted without much doubt.

The accompanying figure of this species is from a specimen from *Arctostaphylos* sp., near Redding, Calif. Attention should be called to

the presence of numerous ducts near the margins of the last abdominal segment anterior to the pygidium. The presence of these ducts will serve to separate this from the very similar *A. densifloræ* Bremner.

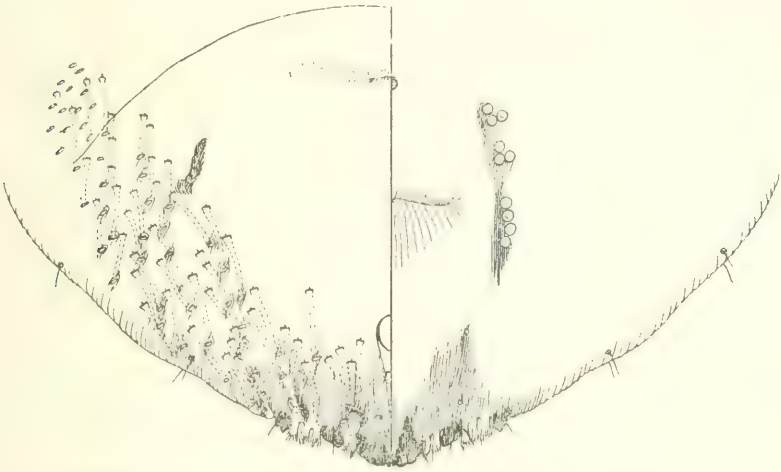

Fig. 25.—*Aspidiotus arctostaphyli* Ckll. and Rob.: pygidium of specimen from near Redding, Calif.

### Aspidiotus coniferarum Ckll.

Fig. 26.

Abundant on the bark of *Libocedrus decurrens,* on the campus of Stanford University. It is probably introduced. It has previously been

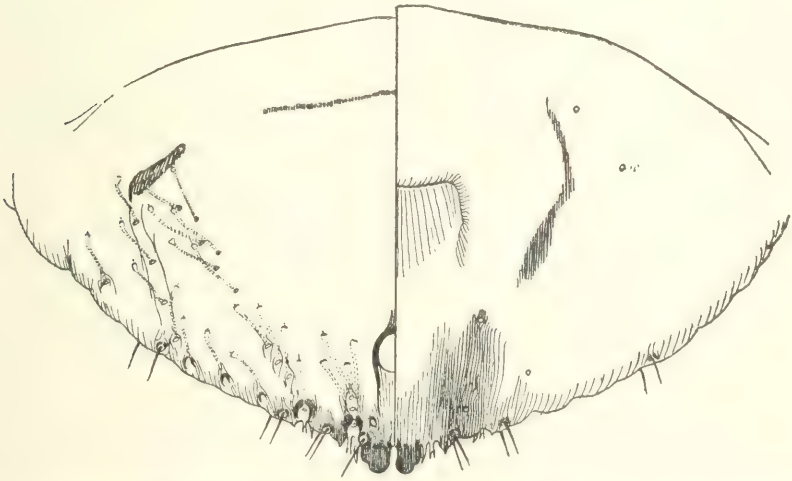

Fig. 26.—*Aspidiotus coniferarum* Ckll.: pygidium of specimen from *Libocedrus decurrens* on the Santa Cruz Peninsula.

recorded only from pine in New Mexico, but I have specimens from *Cupressus guadelupensis* at Riverside and *Libocedrus decurrens,* Mt. Shasta and near Yosemite Valley, Calif.

Through the kindness of Professor Cockerell I have been enabled to examine a specimen from the type material of this species. The only difference observable between this specimen and those from *Libocedrus* and *Cupressus* is that the median lobes of the New Mexico specimen are a trifle broader.

The following notes may be added to the original description.

Derm entirely membranous, except for the pygidium. Tubular ducts confined to the pygidium, these small, slender, varying somewhat in number but always few, their arrangement as indicated in the accompanying figure.

**Aspidiotus densifloræ** Bremner.

Fig. 27.

Occurring quite commonly on the leaves of the tan oak (*Pasania densiflora*) and occasionally on the leaves of *Quercus chrysolepis.*

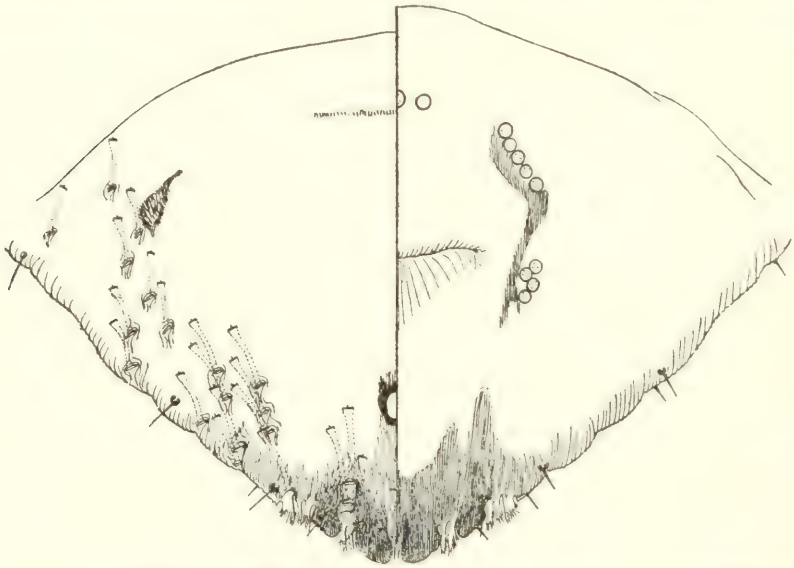

Fig. 27.—*Aspidiotus densifloræ* Bremner: pygidium of specimen from *Pasania densiflora* on the Santa Cruz Peninsula.

I present a new figure of the pygidium. This species very closely resembles *A. arctostaphyli* but may be distinguished by the absence of a cluster of ducts at each lateral margin on the first abdominal segment anterior to the pygidium.

**Aspidiotus ehrhorni** Coleman.

Fig. 28.

Within this area this species has been taken only from the bark of *Pseudotsuga taxifolia.*

The original description is in error in the statement that there are three pairs of "incisions" on the pygidium. There are but the usual two

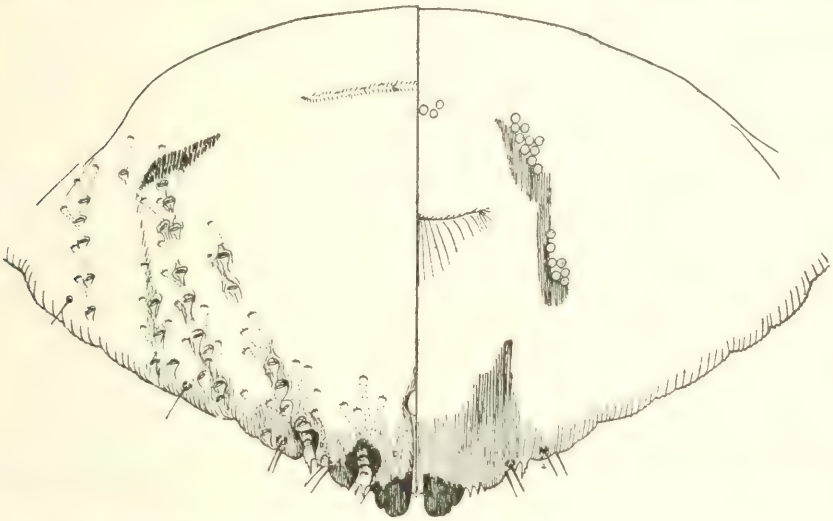

Fig. 28.—*Aspidiotus ehrhorni* Coleman: pygidium of specimen from *Pseudotsuga taxifolia* on the Santa Cruz Peninsula.

pairs. I may note further that the derm is membranous, except for the pygidium, and that the tubular ducts are confined to the pygidium, except for one or two at the lateral margins on some of the abdominal segments. The figure accompanying the original description is quite inadequate and I present a new figure.

**Aspidiotus hederæ** (Vall.).

Sharing with *A. rapax* the distinction of being one of the two most common scales in this area. It occurs on an extremely wide range of wild and cultivated hosts, among the former being *Arbutus menziesii, Alnus rhombifolia,* several species of *Arctostaphylos, Umbellularia californica, Ceanothus* sp. and *Sequoia sempervirens.*

**Aspidiotus osborni** Ckll.

Fig. 29.

Quite common on the bark of *Quercus agrifolia,* but rarely seen because of the close resemblance of the scales to the bark of the host.

*Aspidiotus yulupæ* Bremner is a synonym of this. I may note that the derm of the abdomen is membranous, except for the pygidium, and

the dorsal ducts are confined to the pygidium except for a very few along the lateral margins of the abdominal segments.

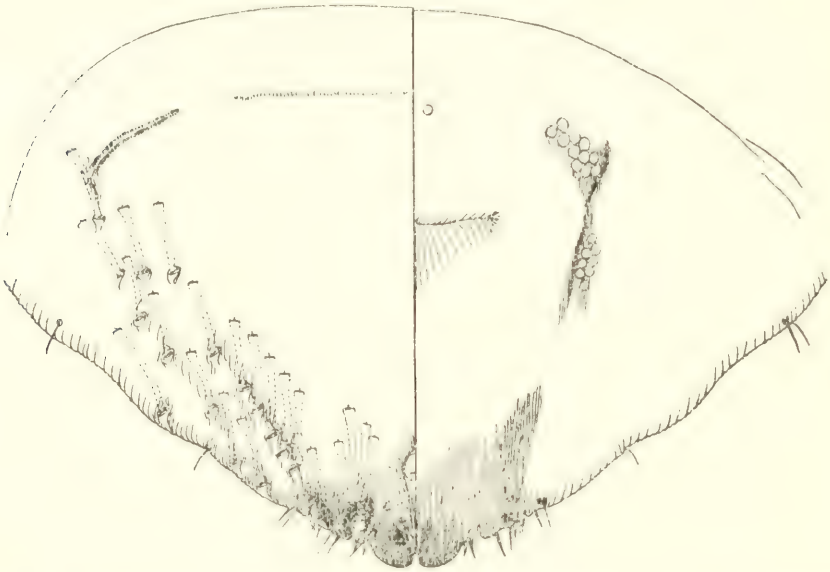

Fig. 29.—*Aspidiotus osborni* Ckll.: pygidium of specimen from *Quercus agrifolia* on the Santa Cruz Peninsula.

This species is very close to *A. ehrhorni,* differing chiefly in having the lateral margin of the median lobes more rounded and in not having a series of ducts in the extreme lateral angles of the pygidium.

### **Aspidiotus perniciosus** Comst.

Although this species was first described from this area it is not now a serious pest. It is quite frequently met with in old orchards, but has not been found on any native host.

### **Aspidiotus pini** Comst.

Figs. 30 and 31.

1881. *Aspidiotus ? pini* Comstock, Rept. U. S. Dept. Agric., 1880, p. 306.
1894. *Aspidiotus abietis* (Schr.); Ckll., *Can. Ent.,* **26**: 190. (Part.)
1903. *Aspidiotus abietis* (Schr.); Fernald, Cat. Coccidæ, p. 251. (Part.)
1903. *Aspidiotus californicus* Coleman, *Jn. N. Y. Ent. Soc.,* **11**: 64.
1903. *Aspidiotus abietes* Comst.; Coleman, *Ibid.,* p. 74. (Misidentification.)

Abundant on various species of pines and on *Pseudotsuga taxifolia.* Probably native.

To the original description of Comstock I have only to add the following notes.

Fully mature female (Fig. 30) more or less circular in form, with the derm very heavily chitinized except for the pygidium and one or two abdominal segments anterior to the pygidium. The pygidium is retracted into the ventral side of the abdomen. Specimens taken at this stage are difficult to study morphologically owing to the heavy chitinization of the derm.

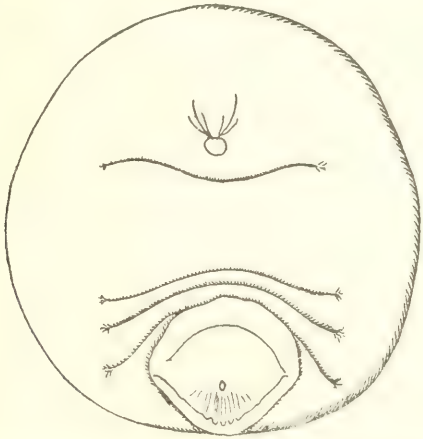

Fig. 30.—*Aspidiotus pini* Comst.: ventral aspect of adult female from specimen from pine, Ithaca, N. Y.

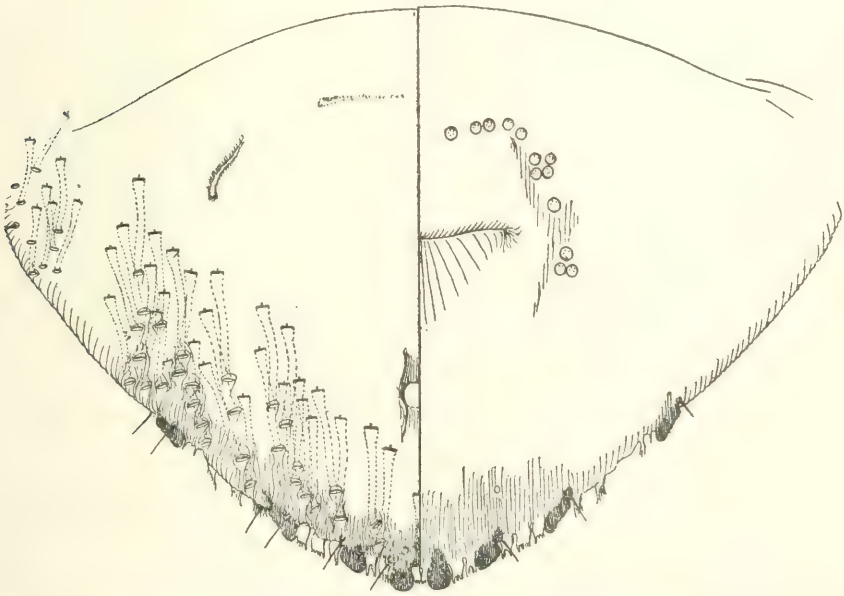

Fig. 31.—*Aspidiotus pini* Comst.: pygidium of specimen from pine, Ithaca, N. Y.

In the early adult female the derm is membranous throughout, except for the pygidium. At this stage there may be seen a cluster of numerous ducts at the lateral margin of each of the abdominal segments anterior to the pygidium. The dorsal ducts are very numerous and are arranged as shown in Fig. 31.

Notes: I am here restoring, at least temporarily, the name *Aspidiotus pini* Comstock. This has been placed by Cockerell as a synonym of *A. abietis* (Schr.) but material in my hands, representing both species, indicates that they are possibly distinct. *Aspidiotus californicus* Coleman is certainly a synonym of *A. pini.* I shall discuss these species at length in another paper dealing with the conifer-infesting species of this group occurring in North America.

### **Aspidiotus rapax** Comst.

Like *A. hederæ,* and frequently in company with it, this species occurs on a wide range of hosts. At times it is so abundant on the native shrubs of the genus *Ceanothus* as to be destructive.

### **Aspidiotus shastæ** Coleman.

Fig. 32.

On *Sequoia sempervirens,* at times in great abundance, always on the leaves.

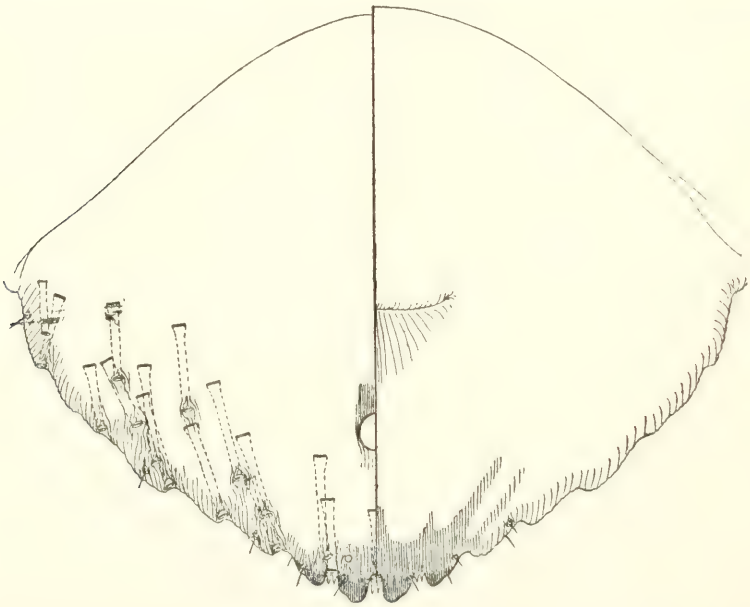

Fig. 32.—*Aspidiotus shastæ* Coleman: pygidium of specimen from *Sequoia sempervirens* on the Santa Cruz Peninsula.

This is the species described by Coleman as *A. coniferarum* var. *shastæ* and more recently by Marlatt as *Aonidia juniperi*. It is certainly congeneric with and perhaps the same as *Aspidiotus* (= *Cryptaspidiotus*) *mediterraneus* Lindinger, which occurs on *Juniperus* in the Mediterranean region and of which I have specimens. The genus *Cryptaspidiotus* must eventually be recognized, but it has not been adequately characterized, and in the present state of our knowledge of this group to limit it is difficult. I therefore retain the species for the present in *Aspidiotus*.

## Genus **CHRYSOMPHALUS** Ashmead.

### **Chrysomphalus rossi** (Maskell).

Fig. 33.

On *Araucaria bidwilli*, on the campus of Stanford University. An introduced species. Specimens from this locality agree entirely with material from Australia determined by Froggatt as this species.

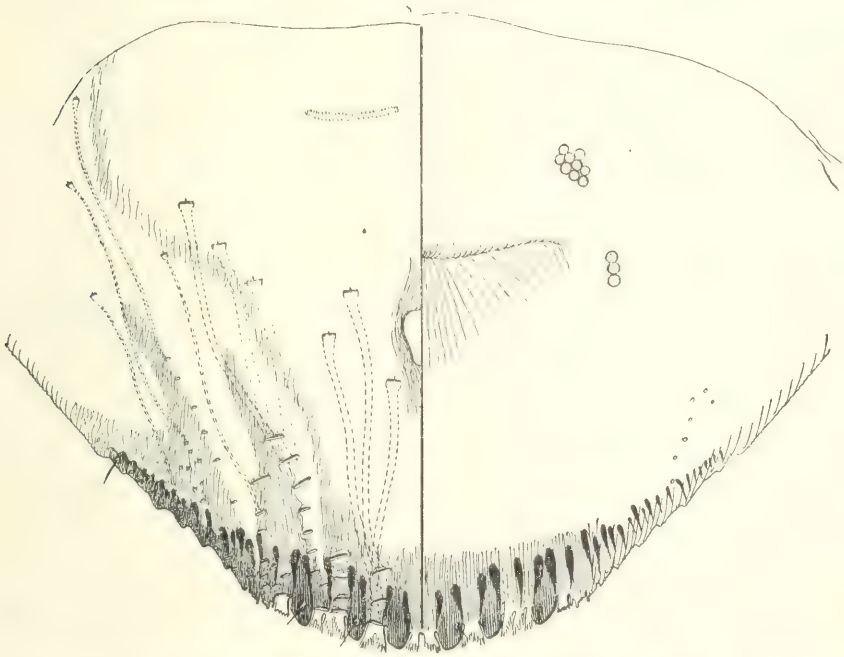

Fig. 33.—*Chrysomphalus rossi* (Maskell) : pygidium of specimen from *Araucaria* on the Santa Cruz Peninsula.

The figure of the pygidium given by Green in the Coccidæ of Ceylon is hardly as detailed as is desirable, and I present a new figure. The mixture of large and small ducts on the dorsum is a characteristic feature of the species.

## Genus **TARGIONIA** Sign.

The type of this genus is a somewhat Chrysomphaloid form with which probably few of the North American species now referred to this genus are strictly congeneric. I consider that the one species coming within the scope of this paper, *T. dearnessi* Ckll. and Par., should probably be referred elsewhere and that a new genus will eventually be necessary for this and certain other closely allied species. I would especially call attention to the nature of the ducts in all these species.

### **Targionia (?) dearnessi** Ckll.

Fig. 34.

From *Grindelia cuneifolia* in the salt marshes about San Francisco Bay and from *Eriophyllum confertiflorum* in Stevens Creek Canyon. This species is also abundant on *Corethrogyne* sp. at Cypress Point near Pacific Grove.

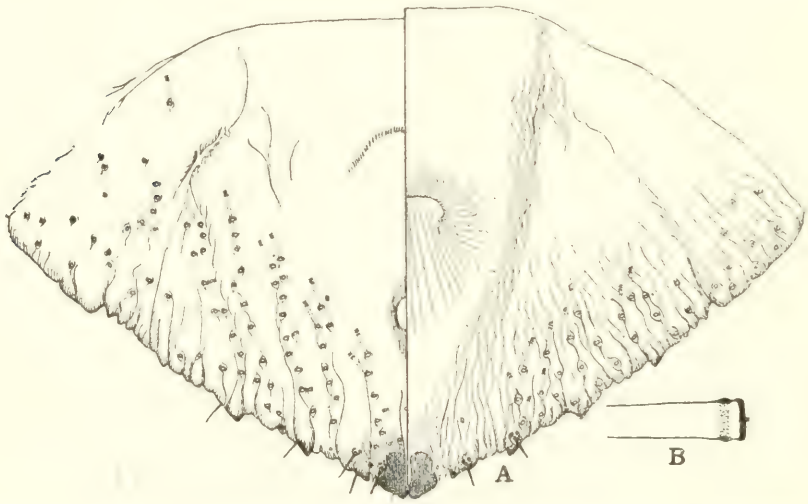


Fig. 34.—*Targionia (?) dearnessi* Ckll.: *A*, pygidium; *B*, duct. From specimen from type material.

The accompanying figure will supplement the original description, and I may note that there are numerous ducts along the lateral margins of the abdomen. All the ducts are very small and short and appear to be of the type indicated in Fig. 34*B*. The determination of the species is based upon the examination of specimens from the type material.

## Genus **ODONASPIS** Sign.

### **Odonaspis graminis** Bremner.

Fig. 35.

Originally described from roots of grass on the Presidio Hills at San Francisco. I have taken the species from a perennial grass near Searsville Lake, San Mateo County.

I present a figure of the pygidium.

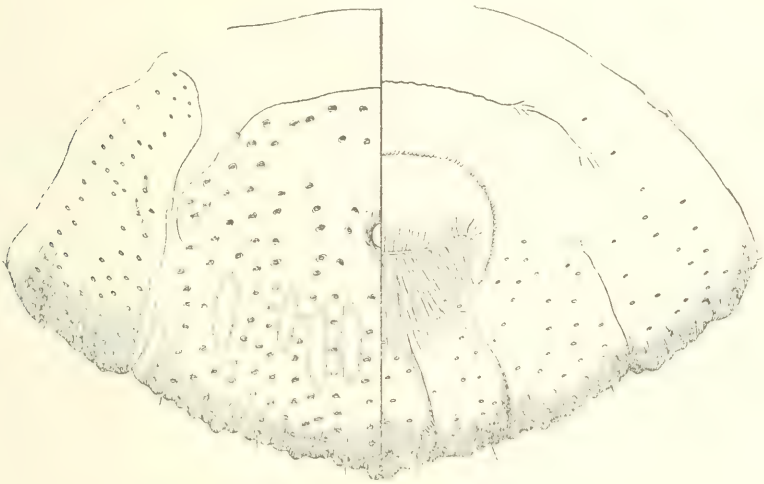

Fig. 35.—*Odonaspis graminis* Bremner: pygidium from specimen from near Stanford University.

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# REPORT UPON A COLLECTION OF COCCIDAE FROM LOWER CALIFORNIA

BY

GORDON FLOYD FERRIS
Instructor in Entomology

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# INTRODUCTION

## Lower California

The peninsula of Lower California, or, to use its Spanish name, Baja California, is a long, slender land finger extending southward for nearly eight hundred miles from its junction with the continent of North America. Its southern extremity, terminating in Cape San Lucas, lies just within the tropics two hundred miles across the Gulf of California from the mainland of Mexico, of which the peninsula is politically a part. It is, in the main, an isolated land whose scanty population clusters about the crumbling missions that stand as symbols of a romantic past through which there moves a procession of priests, pirates, and filibusters succeeded by long years in which the land was virtually forgotten.

It is withal a land to fire the interest of the scientific explorer, especially of the botanist, for its isolation and its climate have combined to develop what has been characterized as the strangest desert flora in the world. Yet until comparatively recent years but little has been known concerning the biota of the peninsula. The existing knowledge is based largely upon the explorations made by Dr. Gustav Eisen under the auspices of the California Academy of Sciences, and by Mr. T. S. Brandegee during the closing years of the past century, the results of the extended travels of Nelson and Goldman, supported by the Bureau of Biological Survey of the United States Department of Agriculture, having for the most part not yet been made public.

In certain fields enough work has been done to give a reasonably clear conception of the nature of the life of the peninsula, but there remain some groups that have been practically untouched. Among these groups are the insects. Rather extensive entomological collections were made by Dr. Eisen in the southern portion of the peninsula, the region to which scientific writers have applied the name "Cape Region," but even here practically no more than a beginning has been made. Throughout the remainder of the area almost no work at all has been done and concerning certain groups there is no information whatsoever. From all this great area, as far as I am able to determine, not a single species of the Coccidae or scale insects has heretofore been recorded, although the richness of the flora is in itself evidence that this group should be well represented. A few species have been taken from Carmen Island in the Gulf of California, but none from the peninsula itself.

The present writer has long been keenly aware of the possibilities of extending our knowledge of these insects by explorations within this region. With the financial support of the California Academy of Sciences, the Department of Entomology of Stanford University and the United States Bureau of Entomology, it became possible to spend some time during the summer of 1919 in the southern portion of the peninsula for the purpose, in part, especially of collecting these insects. It is upon the results of this work that the present paper is based.

## ITINERARY

Except for a few hours spent ashore at Ensenada, a port about fifty miles south of the United States boundary, the collecting was confined to the extreme southern portion of the peninsula of which I have already spoken as the Cape Region. Accompanied by Mr. J. R. Slevin, assistant curator of Herpetology of the California Academy of Sciences, I landed at La Paz, a port about one hundred miles north of Cape San Lucas on the gulf side of the peninsula. Here a few days were spent while arranging the necessary formalities connected with passing our equipment through the customs, and then, with riding animals and a pack train, we started upon a circuit of the region.

Stops of a few days each were made at San Pedro, Triunfo, San Antonio, San Bartolomé (or, as it is commonly called by the natives and will be called throughout this paper, San Bartolo), the Eureka ranch at La Rivera, Agua Caliente, Miraflores, San Jose del Cabo and Cabo San Lucas. From the latter place the route lay by the roughest of trails over the mountains to Todos Santos on the western coast. From Todos Santos a trip of a few days was made to La Laguna, a meadow near the summit of the Laguna Mountains at an altitude of perhaps 5,000 feet, where one finds himself in surroundings reminiscent rather of regions some hundreds of miles to the northward than of the lowlands immediately about the base of the mountains. From Todos Santos we then returned directly across the peninsula to La Paz.

## CHARACTERISTICS OF THE SCALE INSECT FAUNA

There are listed in the following pages 85 species of Coccidae. Of these, two, *Pseudodiaspis larreae* and *P. dentilobis* were not obtained in the peninsula, although the former doubtless occurs there, but are included because of their intimate connection with certain other included species. Two others, *Ehrhornia cupressi* and *Aspidiotus densiflorae* are represented by specimens taken from herbarium material from Guadeloupe Island, an island in the Pacific about two hundred miles off the coast of Lower California. Three species, *Erium lichtensioides* (Ckll.), *Pseudo-*

*coccus eriogoni* (Ehrh.), and *Pseudococcus sequoiae* (Coleman), were taken only at Ensenada. The remaining 79 species are from the Cape Region.

Of these 79 species, ten are cosmopolitan or at least tropicopolitan forms, the occurrence of which in this area is of no particular significance. These are the following:

Orthezia insignis (Douglas).
Pseudococcus filamentosus (Ckll.).
Pseudococcus virgatus (Ckll.).
Saissetia oleae (Bern.).
Saissetia nigra (Nietn.).
Chrysomphalus aurantii (Maskell).
Chrysomphalus aonidum (L.).
Lepidosaphes gloveri (Pack.).
Aspidiotus lataniae Sign.
Aspidiotus rapax (Comst.).

One species, *Aspidiotus spinosus* Comst., has previously been recorded from greenhouses in eastern United States and in England, but is of unknown origin. It is almost certainly introduced in Lower California also. Three species are neotropical in origin, but are probably introduced in this particular area. These are the following:

Asterolecanium pustulans (Ckll.).
Ceroplastes cirripediformis Comst.
Pseudoparlatoria parlatorioides (Comst.).

Six species, of which three are from oaks, are widely distributed throughout the United States and doubtless northern Mexico as well, these being the following:

Eriococcus quercus (Comst.).
Pseudococcus maritimus (Ehrh.).
Chionaspis pinifoliae (Fitch).
Chionaspis quercus Comst.
Aspidiotus diffinis Newst.
Aspidiotus osborni Ckll. and Newell.

Twenty-four species I am identifying as forms that have previously been recorded from southwestern United States or northern Mexico and that are more or less characteristic of that region. These are the following:

Icerya rileyi Ckll.
Steatococcus morrilli (Ckll.).

Dactylopius confusus (Ckll.).
Dactylopius tomentosus (Lam.).
Eriococcus cryptus Ckll.
Eriococcus bahiae Ehrh.
Eriococcus stanfordianus Ferris.
Pseudococcus salinus (Ckll.).
Trionymus smithii (Essig).
Puto yuccae (Coq.).
Phenacoccus helianthi (Ckll.).
Toumeyella mirabilis Ckll.
Ceroplastes irregularis Ckll.
Lichtensia lycii Ckll.
Ancepaspis tridentata (Ferris).
Pseudodiaspis yuccae (Ckll.).
Pseudodiaspis multipora Ferris.
Diaspis arizonica Ckll.
Diaspis echinocacti (Bouché).
Xerophilaspis prosopidis (Ckll.).
Lepidosaphes concolor (Ckll.).
Lepidosaphes mimosarum (Ckll.).
Aspidiotus candidulus Ckll.
Targionia yuccarum (Ckll.).

One species I am referring doubtfully to *Eriococcus palmeri* Ckll., a species heretofore recorded only from Carmen Island in the Gulf of California.

Twenty-nine species are here described as new. It is not impossible that some of these will eventually prove to be identical with species already described from Mexico. Some are very closely related to northern forms, being perhaps in the nature of subspecies as that term is understood by mammalogists and ornithologists, and others will almost certainly be found to occur in the United States and northern Mexico. A few may prove to be truly autochthonous in the peninsula. The list of new species is as follows:

Steatococcus tabernicolus.
Orthezia caudata.
Asterolecanium cristatum.
Fonscolombia peninsularis.
Eriococcus tillandsiae.
Eriococcus paucispinus.
Xerococcus fouquieriae.

Phenacoccus franseriae.
Aclerda attenuata.
Pulvinaria peninsularis.
Toumeyella cerifera.
Protodiaspis lagunae.
Ancepaspis novemdentata.
Diaspis simmondsiae.
Pseudodiaspis prosopidis.
Pseudodiaspis elaphrii.
Pseudodiaspis ruelliae.
Pseudodiaspis magna.
Chionaspis distichlii.
Lepidosaphes acuta.
Lepidosaphes calcarata.
Lepidosaphes obtecta.
Lepidosaphes peninsularis.
Odonaspis litorosa.
Odonaspis fistulata.
Chrysomphalus enceliae.
Chrysomphalus induratus.
Aspidiotus chortinus.
Aspidiotus pedilanthi.

Two of these species, *Odonaspis fistulata* and *Aclerda attenuata,* apparently have their nearest relatives in the East Indian region, as will be pointed out in the discussion concerning them. It is possible that they have been introduced into Lower California on bamboo, but in the present state of our knowledge speculation is idle.

Four species are left unidentified for lack of material or other reasons, but are listed for the sake of completeness.

It is obvious from the above résumé that the affinities of the scale insect fauna of this region are most intimately related with the fauna of southwestern United States and northwestern Mexico, which is quite in accord with the known facts concerning the other groups that have been studied to any extent. What connection, if any, there may be with the fauna of the tropical west coast of Mexico below Mazatlan, remains to be determined, for the scale insects of the latter region are still almost entirely unknown.

In general the collector in this area cannot fail to be impressed by the absence of conspicuous forms, especially in the Coccinae. A very large proportion of the species are only to be found by the stripping off of loose bark, the uprooting of such things as may be uprooted, or the

digging about the roots of those that may not. Practically all of the soft scales are attended by ants of the genus *Crematogaster* and are protected by shelters of a papery consistency built by the ants across the cracks in which the scales are hidden or even over individuals that may otherwise be freely exposed upon the twigs. It is frequently only by the presence of the ants that any indication is given of the presence of the scales.

## TYPES

In the case of all the new species a holotype has been designated, and these types are deposited in the Stanford Collection of Coccidae. Paratypes of all the new species, except *Steatococcus tabernicolus*, will be deposited in the National Collection of Coccidae.

## ACKNOWLEDGMENTS

To the authorities of the California Academy of Sciences, to Dr. W. K. Fisher and Professor R. W. Doane of Stanford University, and to Dr. L. O. Howard of the United States Bureau of Entomology, are due acknowledgments for assistance in obtaining the financial support that made possible this report. To Mr. Harold Morrison of the Bureau of Entomology I am indebted for the comparison of certain species with types in the National Collection of Coccidae. I am also indebted to my wife, Roxana S. Ferris, for much valuable assistance in the identification of various plants.

# SYSTEMATIC TREATMENT

## Genus **ICERYA** Sign.

### **Icerya rileyi** Ckll.

*Previous records.* From *Prosopis* and *Covillea* in New Mexico and Arizona.

*Lower California records.* From undetermined mimosaceous shrub and *Prosopis* sp. at San Antonio; *Prosopis* sp., *Casuarina* sp., and undetermined ornamental at San Jose del Cabo; undetermined mimosaceous shrub on Mt. San Bernardo; *Franseria* sp., at Todos Santos.

Notes: It is with much doubt that I assign all these specimens to *I. rileyi.* There is some difference in the form and amount of the secretions, the specimens from *Franseria* having the ovisac very definitely yellow at the base while the others are all white, and there is some difference in the size and number of the setae on the body, the examples from the various hosts at San Jose del Cabo and Mt. San Bernardo having the setae more numerous and more slender.

Several species of this genus have been described from Mexico and slide mounts of some of these are at hand. It is obvious that all of these forms are very closely related and only a careful study of much material, and that the most favorable, can settle their relationships. I therefore place the Lower California material for the present with *I. rileyi,* the first described.

## Genus **STEATOCOCCUS** n. gen.[1]

1919. *Paleococcus* (part), Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 7.

Monophleboid Coccidae of the general type of the genus *Icerya,* that is: legs, antennae, and mouth parts present in all stages; anal tube lacking except in the first stage and in this stage very small; adult male alate, with but the caudal pair of fleshy appendages present; abdominal spiracles present only on the last three segments; antennae 10-11-segmented. Differing from *Icerya* in the possession of a marsupium which opens through a large, circular opening just behind the posterior legs, in this respect resembling *Mimosicerya* (= *Clypeococcus*), but differing from the latter in not having the derm chitinized.

Type of the genus *Paleococcus morrilli* Ckll. Other included species, *Paleococcus mexicanus* (Ckll. and Parrott), *P. plucheae* (Ckll.), *P. townsendi* (Ckll.), and *P. tabernicolus* n. sp.

---

[1] A single specimen of a species of this genus was taken from mistletoe at San Pedro, but was unfortunately lost. This specimen represented an undescribed species characterized by the presence of several large spine-like processes on the dorsum of the cephalothorax.

I have previously (ref. cited) called attention to the fact that the species of the type of *Paleococcus morrilli* probably are not congeneric with the type of *Paleococcus*, and have suggested that the genus *Crypticerya* might be revived for them. However, there have since come to hand examples of *C. rosae* (the type of this genus) and this proves to lack the marsupium that is a distinctive character of *Steatococcus*. The new genus is evidently of the type of *Mimosicerya* (= *Clypeococcus* Newst.), the type of which is *Paleococcus hempeli*, but from this it differs most noticeably in the unchitinized derm and the absence of the prominent clypeal region.

The genus as at present known is characteristic of southwestern United States and northern Mexico, the "Sonoran region" of biologists.

### **Steatococcus morrilli** (Ckll.) n. sp.

1914. *Paleococcus morrilli* Ckll., *Ent. News:* **25**; 110.

1919. *Paleococcus morrilli* Ckll., Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 8, fig. 2.

*Previous records.* Known only from *Acacia greggii* in Arizona.

*Lower California records.* From *Haematoxylon boreale,* San Pedro, beneath the surface of the soil, associated with ants.

### **Steatococcus tabernicolus** n. sp.

*Type* from *Prosopis* sp. near La Rivera.

*Habit.* On the smaller twigs of the host beneath shelters built by ants. Owing to the attentions of the ants the Coccids were in all cases entirely devoid of secretion.

*Morphological characteristics.* Length (mounted on slide) 5 mm. Derm entirely destitute of large spines or setae, even between the bases of the antennae, except for a few quite large submedian setae on the ventral side behind the opening of the marsupium. Depression containing the anal opening beset with numerous small spines and a few such spines scattered over the body. Margin of the marsupial opening with numerous pores and the remainder of the body almost without pores except for the head and the posterior portion of the abdomen, where they are quite numerous. Antennae 10-segmented.

Immature stages not seen.

Notes: Only two specimens of this species are available for study and it might be thought that the absence of large spines is due to the fact that the spines have been broken off, but were this the case the bases of the spines would still remain, affording evidence of their presence. The almost complete absence of large setae at once distinguishes this species from the other members of the genus.

## Genus **ORTHEZIA** Bosc.

### **Orthezia caudata** n. sp.

Fig. 1.

*Type* from a very large, shrubby composite, probably *Encelia palmeri,* at Todos Santos.

*Habit.* Dried specimens, with sac, about 5-6 mm. long, the sac occupying about half the total length. The lateral margins bear short tassels and in fully grown examples the dorsal plates extend to the margins, entirely concealing the derm, although in immature examples

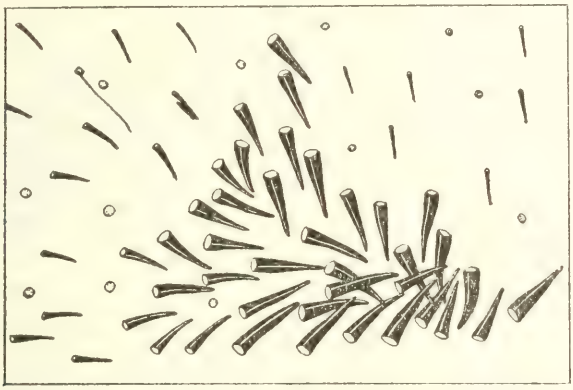

Fig. 1.—*Orthezia caudata* n. sp.: patch of spines from dorsum of abdomen.

there is a distinct, submedian bare area on each side. Arising from about the anus is a single long, slender process which extends fully to the end of the ovisac. Ovisac moderately stout, curved upward at the apex, composed of a single broad ventral plate and several narrow dorsal plates.

*Morphological characteristics.* Derm with the usual areas of clubbed spines and also with areas of much larger, very conspicuous black spines. Those of the smaller size are rather sparsely distributed over the entire dorsum while those of the larger size are arranged in conspicuous clusters (Fig. 1). There appears to be much variation in the size of these clusters and their arrangement, but in general it appears to be about as follows: each thoracic segment with a large, submarginal cluster on each side and each of the first four abdominal segments with two small clusters on each side, although these may in part be lacking. Abdominal spiracles very small, apparently but five pairs present.

Notes: The distinctive feature of this species in life is the long, caudal wax tassel. Morphologically it differs from any other species known to me by the presence of the conspicuous areas of large spines.

### **Orthezia insignis** Douglas.

*Previous records.* A widely distributed tropical and greenhouse species.

*Lower California records.* Abundant upon *Capsicum* sp. ("Chile") in a garden at La Paz.

## Genus **ASTEROLECANIUM.**

### **Asterolecanium pustulans** (Ckll.).

Fig. 2.

*Previous records.* A widely distributed species in the neotropical region on numerous hosts.

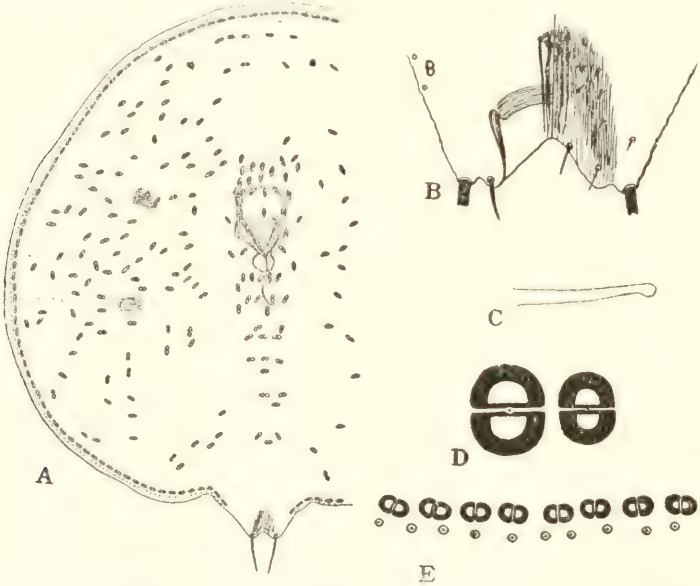


Fig. 2.—*Asterolecanium pustulans* (Ckll.).: A, adult female; B, anal lobes, left half dorsal, right half ventral; C, type of duct; D, types of pores, the larger pore from the dorsum, the smaller from the marginal series; E, pores of the marginal series.

*Lower California records.* From oleander at La Paz and Miraflores, *Vachellia farnesiana* at Todos Santos and mango at San Bartolo.

*Habit.* Normally a pit-forming species, but the examples from mango and *Vachellia* were not in pits. The dorsum, when not rubbed, is covered with great numbers of short, curling, reddish wax filaments.

*Morphological characteristics.* Adult female (on slide) .9 mm. long, the body (Fig. 2A) nearly circular with the anal region projecting slightly. Pores of the 8-shaped type abundant on the dorsum, slightly

larger than those of the marginal series (Fig. 2D). Marginal pores arranged in a definite single row accompanied by a row of small circular pores (Fig. 2E). Stigmatic depressions marked by numbers of these circular pores which form a series from the margin to the corresponding spiracles. Anal lobes (Fig. 2B) quite prominent, closely united, their median area on the ventral side quite heavily chitinized. Tubular ducts of the type indicated in Fig. 2C.

Notes: The specimens at hand agree entirely with examples from fig at Tampico, Mexico, and from oleander at quarantine from Mexico.

### **Asterolecanium cristatum** n. sp.

Fig. 3.

*Type* from *Heteromeles arbutifolia* at La Laguna. Also from *Jatropha canescens* ("lomboi") at San Antonio; *Celosia floribunda* ("bledo") at San Bartolo and San Jose del Cabo; *Tapirira edulis* ("ciruela") at San Bartolo; *Encelia palmeri* at Todos Santos.

*Habit.* Test about 1.5 mm. long, oval, high convex, in unrubbed specimens entirely covered with short curling wax filaments and with numerous long filaments which are as long as the test itself, these fre-

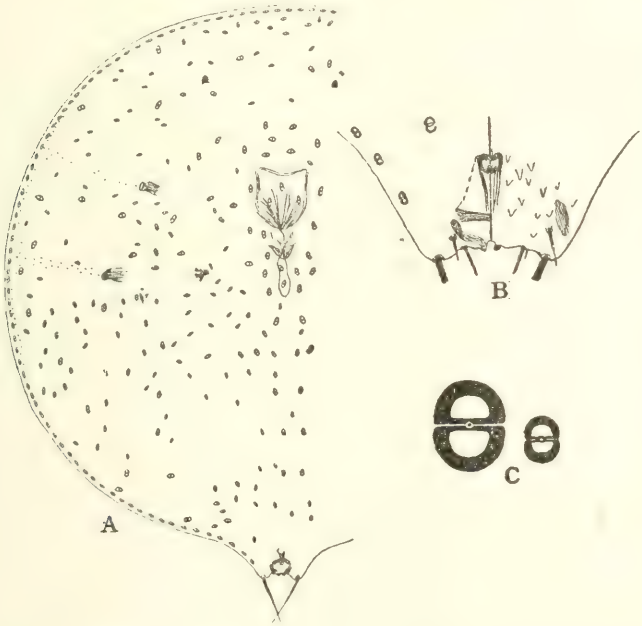


Fig. 3.—*Asterolecanium cristatum* n. sp.: A, adult female, to show distribution of pores; B, anal lobes, left half dorsal, right half ventral; C, types of pores, the larger from the dorsum, the smaller from the marginal series.

quently forming a prominent crest. Rubbed specimens of a uniform green. In no case was the species observed to cause the formation of pits.

*Morphological characteristics.* Adult female (Fig. 3A) (on slide) about 1 mm. long, nearly circular, the caudal region projecting slightly. Margin with a series of small 8-shaped pores which is continuous except for the caudal region, this series accompanied by a row of small, circular pores for a short distance on each side of the stigmatic depressions only. Dorsal pores numerous, of two sizes, the smaller size slightly larger than those of the marginal series, the others about twice as long (Fig. 3C) with some intergradation between the two extremes. Anal lobes (Fig. 3B) closely united, not chitinized ventrally. Anal ring with six slender setae. Tubular ducts numerous, of the same type as in *A. pustulans.*

Notes: Among the specimens which I refer to this species there is a considerable degree of difference, examples from *Celosia* and *Jatropha* having the dorsal pores fewer and with the large pores distinctly concentrated in the median region. It is possible that two species are involved but the speicmens agree in other respects and the material available is not sufficient to permit the study of extensive series.

The species differs from *A. pustulans* most conspicuously in the incomplete marginal series of circular pores and also in the variable size of the dorsal pores.

## Genus **DACTYLOPIUS** Costa.

### **Dactylopius confusus** (Ckll.).

*Previous records.* Montana, Arizona, and New Mexico, on various species of *Opuntia*, and under subspecific names from various other countries where it has been introduced.

*Lower California records.* From flat *Opuntia* ("nopal"), at La Paz and La Palma.

### **Dactylopius tomentosus** (Lam.).

*Previous records.* Arizona, New Mexico, and southwestern California and England (introduced from Arizona), on *Opuntia.*

*Lower California records.* From a cylindrical *Opuntia* ("cholla"), at La Paz, San Jose del Cabo, and Cabo San Lucas.

## Genus **ERIOCOCCUS** Targ.

### **Eriococcus bahiae** Ehrh.

1920. *Eriococcus bahiae* Ehrh., Ferris: "Scale Insects of the Santa Cruz Peninsula," Stanford University Publications, *Biological Sciences,* 1:1:17, fig. 4.

*Previous records.* From *Eriophyllum confertiflorum,* near Stanford University, Calif. (type), and *Gutierrezia* sp., near Las Cruces, New

Mexico. It has also been recorded from France, this latter record possibly the result of misidentification.

*Lower California records.* From the roots of *Dalea emoryi* at La Paz and Todos Santos; *Porophyllum gracile* ("yerba del venado") near San Jose del Cabo; mimosaceous shrub at San Antonio; *Chamaecyce* sp. ("golondrina") between La Paz and San Pedro.

Notes: The specimens from *Porophyllum* agree very closely with typical examples, the others differ somewhat but yet come within the range of variation of the species.

### **Eriococcus cryptus** Ckll.

Fig. 4.

*Previous records.* Known only from roots of *Gutierrezia* in New Mexico.

*Lower California records.* From *Atriplex* sp. at La Paz.

*Habit.* Sac about 3.5 mm. long, white, smooth and closely felted, rather brittle.

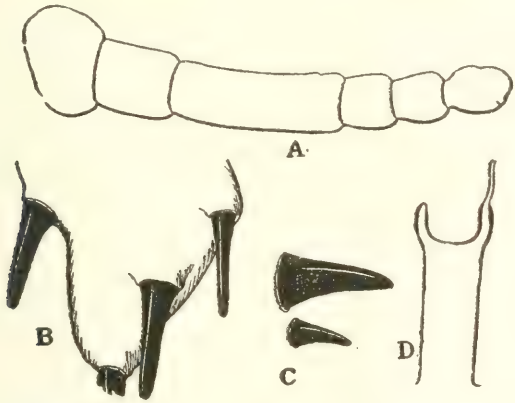


Fig. 4.—*Eriococcus cryptus* Ckll.: A, antenna; B, dorsal aspect of anal lobe; C, types of spines; D, type of duct.

*Morphological characteristics.* Adult female (on slide) 2.5 mm. long, of ordinary form. Dorsum of the body entirely destitute of spines except for a very few that are extremely small. Lateral margins of each abdominal segment with a single, large, stout, curved spine accompanied by a single much smaller spine of similar form (Fig. 4C). Along the margin of the head and thorax these spines form an irregularly single or double row. Anal lobes (Fig. 4B) prominent, slightly chitinized, each with two slender setae ventrally and three spines dorsally, these somewhat

smaller and straighter than the larger of the marginal spines. Anal ring with eight setae, these about half as long as the anal lobe setae. Legs with the tarsus slightly longer than the tibia, the claw with a distinct tooth, the posterior coxae with numerous small pores beneath. Antennae (Fig. 4A) 6-segmented, the third segment as long as or even slightly longer than the last three together. Wax ducts (Fig. 3D) with a rather broad, deep and symmetrical cup.

Notes: Examples from this material have been compared by Mr. Morrison with specimens in the National Collection at Washington and this determination has been confirmed by him. The species was originally described as a variety of *E. tinsleyi*, but the latter species is quite different, having the dorsum thickly beset with stout spines.

## **Eriococcus paucispinus** n. sp.

Fig. 5.

*Type* from *Celosia floribunda* ("bledo"), Cabo San Lucas.

*Habit.* Sac presenting no distinctive characters.

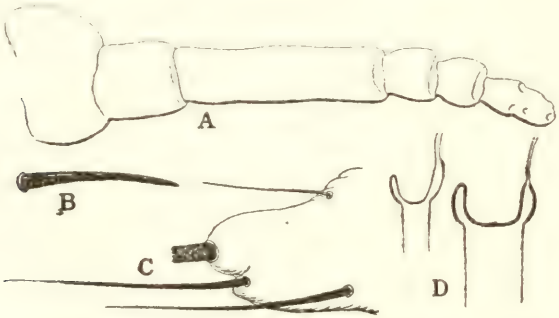


Fig. 5.—*Eriococcus paucispinus* n. sp.: A, antenna; B, type of spine; C, anal lobe; D, types of ducts.

*Morphological characteristics.* Adult female (on slide) 3 mm. long. Derm entirely destitute of spines and setae except for the usual slender setae on the venter of the abdomen, a very few extremely small spines on the dorsum and a slender spine (Fig. 5B) at the lateral margin of the last two or three abdominal segments. Anal lobes (Fig. 5C) prominent and quite heavily chitinized, each with two quite long and slender setae on the dorsum and two somewhat longer setae on the ventral side. Antennae (Fig. 5A) 6-segmented, the third segment longer than any three others together. Legs with the tarsus slightly longer than the tibia, the claw with a denticle, the hind coxae with numerous pores beneath. Wax ducts (Fig. 5D) of two sizes, some quite small and with the cup

deep and distinctly asymmetrical, the others larger and with the cup broad and shallow. Anal ring with eight setae, these about half as long as the anal lobe setae.

Notes: The only described species known to me that at all approaches this is *E. inermis* Green, from grass in England. The two are very similar in the absence of spines but differ in that *E. inermis* bears stout spines instead of slender setae on the anal lobes.

### **Eriococcus palmeri** Ckll.

Two specimens were taken from *Ruellia* sp. at Todos Santos which Mr. Morrison considers possibly to be nearest *E. palmeri* Ckll. In view of the scanty material they may be placed with this species for the present. It has previously been recorded from *Bourreria sonorae* on Carmen Island in the Gulf of California.

### **Eriococcus quercus** (Comst.).

1920. *Eriococcus quercus* (Comst.); Ferris: "Scale Insects of the Santa Cruz Peninsula," Stanford University Publications, *Biological Sciences,* 1:1:19, fig. 6.

*Previous records.* Widely distributed throughout the United States on various species of *Quercus,* ranging across the continent.

*Lower California records.* From *Quercus brandegeei,* between La Rivera and Santiago.

Notes: But a single example of this species was obtained, this agreeing quite closely with examples from *Quercus agrifolia* in California.

### **Eriococcus stanfordianus** Ferris.

1920. *Eriococcus stanfordianus,* Ferris: "Scale Insects of the Santa Cruz Peninsula," Stanford University Publications, *Biological Sciences,* 1:1:21, fig. 7.

*Previous records.* Known only from the vicinity of Stanford University, California, from unknown host.

*Lower California records.* From *Cassia* sp. at Todos Santos; *Mimosa* sp. at San Pedro; feral domestic cotton at San Jose del Cabo.

Notes: It is only with much hesitation that I refer all these specimens to this species. The specimens from *Cassia* agree very closely with the type, except for the presence of a very few small spines on the dorsum of the abdomen in addition to the large spines. Those from *Mimosa* likewise agree quite closely except that the spines are noticeably shorter and stouter than in the type. The specimens from cotton differ most widely, there being many smaller spines on the dorsum which at times approach the larger spines in size. Specimens from this latter lot have been compared by Mr. Morrison with the *Eriococcus* material in the National Collection and he informs me that he cannot connect these with any species in the collection. It may be noted that these approach *E. toumeyi* Ckll. (*E. quercus* var. *toumeyi* Ckll.) in spine characters.

**Eriococcus tillandsiae** n. sp.

Fig. 6.

*Type* from *Tillandsia recurvata,* about midway between Cabo San Lucas and Pescadero.

*Habit.* Occurring among the crowded leaf bases of the host. Sac not noted.

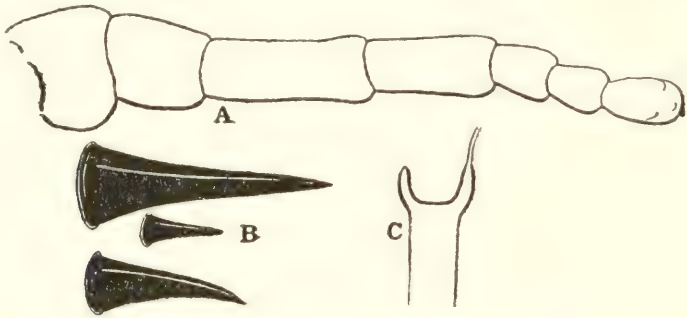


Fig. 6.—*Eriococcus tillandsiae* n. sp.: A, antenna; B, types of spines; C, type of duct.

*Morphological characteristics.* Adult female (on slide) about 3 mm. long. Spines confined to the margin of the body except for a few extremely small, sharply-pointed spines on the dorsum. Marginal spines (Fig. 6B) along the abdomen arranged in groups of four to six on each segment, two of these being large, tapering and sharply pointed and sometimes slightly curved, the others of the same shape but smaller. Along the head and thorax the spines are more numerous, forming an irregularly double or triple series and are more nearly of the same size. Anal lobes prominent, weakly chitinized, each dorsally with two spines which are practically of the size and shape of the larger marginal spines, ventrally with three quite long setae, the longest of which is perhaps three-fourths as long as the anal lobe setae. Antennae (Fig. 6A) 7-segmented, quite large and long. Legs with the tarsus slightly longer than the tibia, the claw with a denticle, the posterior coxae with very few pores beneath. Anal lobe setae only slightly longer than the anal ring setae. Wax ducts (Fig. 6C) with the cups quite deep, symmetrical.

## Genus **FONSCOLOMBIA** Licht.

**Fonscolombia peninsularis** n. sp.

Fig. 7.

*Type* from *Asclepias subulata,* near the beach at San Jose del Cabo. Also from *Franseria* (?) sp. at San Antonio.

*Habit.* Occurring on the crowns of the host, surrounded by a small amount of secretion.

*Morphological characteristics.* Adult female (Fig. 7A) (on slide) about 2.5 mm. long, regularly oval. Derm slightly pigmented. Dorsum destitute of all but a few very small, slender spines. Venter with a transverse row of small, slender setae on each abdominal segment and a few

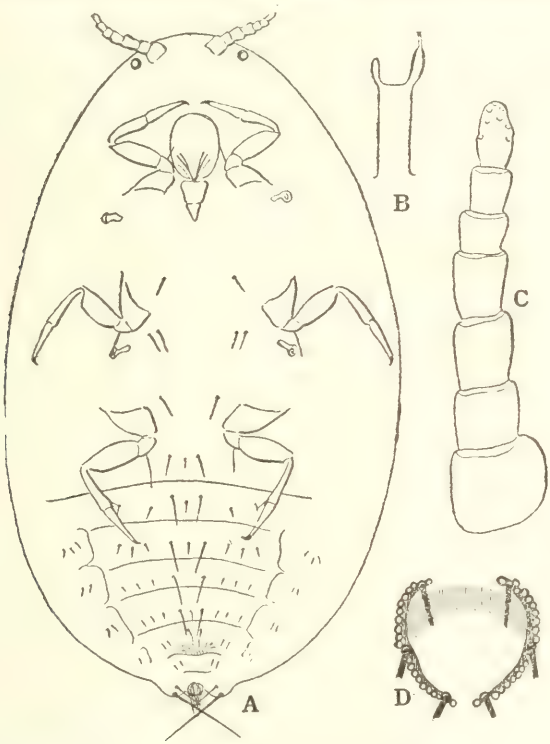


Fig. 7.—*Fonscolombia peninsularis* n. sp.: A, adult female; B, type of duct; C, antenna of adult female; D, anal ring.

such setae on the thorax. Anal lobes low, each with one long and one short seta. Anal ring (Fig. 7D) distinctly cellular, bearing six setae which are somewhat longer than the diameter of the ring. Derm beset with numerous small, multilocular pores, both dorsally and ventrally, especially on the abdomen. Antennae (Fig. 7C) 7-segmented, moderately stout. Legs quite slender, the claw with a very minute denticle. Spiracles small, not surrounded by a ring of pores. Wax ducts (Fig. 6B) with the cup quite deep, slightly asymmetrical.

Immature stages not seen.

Notes: This is the third species of this genus to be recorded from North America. It is very distinct from *F. yuccae* Ferris, and *F. braggi* Ckll. and Rob., the cellular anal ring and the absence of pores about the spiracles serving to distinguish it at once.

## Genus **XEROCOCCUS** n. gen.

Coccidae referable to the subfamily Dactylopiinae (of the Fernald Catalogue) and belonging probably to the *Eriococcus* group, that is without dorsal ostioles, with tubular ducts which have the inner extremity of the basal portion reflexed into a cup and with the anal ring bearing setae. Adult female with the antennae reduced to mere vestiges and with the legs represented by minute chitinized points; body terminating in a pair of large, swollen lobes; anal ring non-cellular, bearing six small setae; tubular ducts numerous, of the ordinary Eriococcine type. Intermediate stages resembling, in general, the adult. First stage with the antennae 6-segmented, of the usual Eriococcine type; anal ring very small and apparently the same in form as that of the adult; dorsum without spines, margins of the abdomen with short, stout spines.

Type of the genus *Xerococcus fouquieriae* n. sp.

Notes: This genus departs rather widely from the usual Eriococcine type, yet it appears to belong to this group. I know of nothing that very closely resembles it.

### **Xerococcus fouquieriae** n. sp.

Fig. 8.

*Type* from *Fouquieria peninsularis* ("palo de Adan") at La Paz.

*Habit.* Occurring beneath the bark scales of the host, imbedded in a considerable amount of amorphous secretion; insects of a bright red color in life.

*Morphological characteristics.* Adult female (Fig. 8A) about 2.5 mm. long (on slide), elongate-oval, tapering posteriorly, the body terminating in a pair of large, swollen lobes. In fully mature individuals the derm becomes quite heavily chitinized throughout, but in younger examples only the posterior portion of the abdomen and the lobes are chitinized, these heavily so. On the anal lobes and the posterior portion of the abdomen the derm presents a somewhat papillate appearance. Antennae (Fig. 8E) very small, consisting of three minute segments. Legs represented by small chitinized points. Derm almost destitute of setae except for a few that are extremely small and slender. Anal ring (Fig. 8D) quite small, almost concealed between the lobes, simple and bearing six small spines. Derm with large numbers of tubular ducts (Fig. 8F) which bear internally a filamentous prolongation and have the larger basal part terminating in a reflexed, somewhat asymmetrical cup. Spiracles (Fig. 8B) rather small, surrounded by many small ducts with a trilocular center (Fig. 8C).

Penultimate stage similar to the adult except that the anal lobes are much less prominent, the tubular ducts fewer and the abdomen bears a row of moderately large spines along the margin.

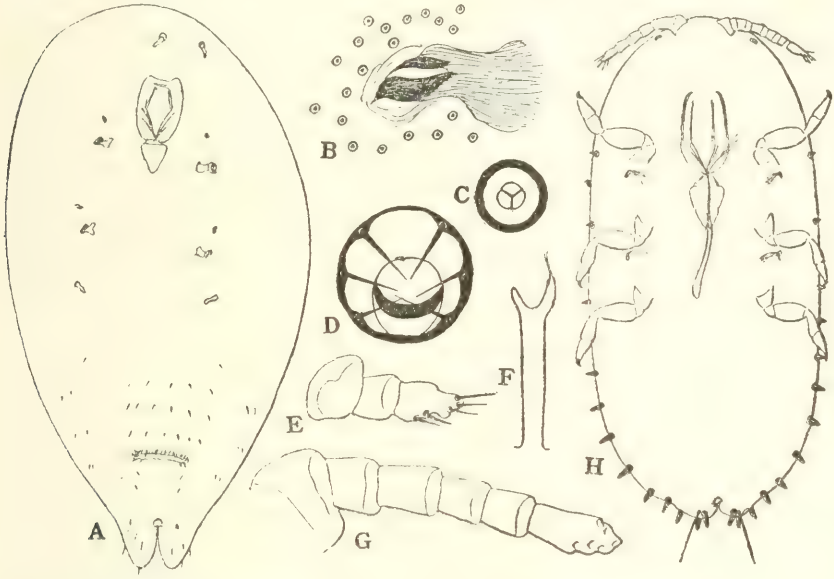


Fig. 8.—*Xerococcus fouquieriae* n. sp.: A, adult female; B, spiracle; C, type of pore; D, anal ring; E, antenna of adult female; F, type of duct; G, antenna of first stage; H, first stage.

First stage (Fig. 8H) with 6-segmented antennae (Fig. 7G). Margins of the body, especially along the posterior portion of the abdomen, beset with a single row of short, stout spines. Anal lobes very low, each with a single slender seta. Anal ring very small, apparently as in the adult.

Notes: The host of this species is restricted to Lower California, but one other species of the same genus, *Fouquieria splendens,* is abundant throughout southwestern United States and northwestern Mexico and it is probable that this Coccid will eventually be found to occur upon it.

## Genus **KERMES** Boitard.

### **Kermes** sp.

*Host and locality.* From *Quercus idonea* on Mt. San Bernardo.

Notes: But a few specimens of this species were taken. Owing to the fact that determinations in this genus are scarcely possible in the existing condition of the literature and to a belief that new species should be described in the genus only when the younger stages are available I refrain from describing this species.

## Genus **EHRHORNIA** Ferris.

### **Ehrhornia cupressi** (Ehrh.).

*Previous records.* From various species of *Cupressus* and from *Libocedrus decurrens* throughout California.

*Lower California records.* From herbarium specimens of *Cupressus guadelupensis* from Guadeloupe Island, about two hundred miles off the coast of Lower California.

Notes: These specimens agree entirely with typical examples except that they lack the chitinization of the anterior portion of the body.

While the specimens here recorded are not from the mainland of Lower California it is to be expected that the species will be found in the northern portion where certain species of *Cupressus* are native in the San Pedro Martir Mountains.

## Genus **PSEUDOCOCCUS** Westw.

### **Pseudococcus eriogoni** (Ehrh.).

1918. *Pseudococcus eriogoni* (Ehrh.), Ferris: "California Species of Mealy Bugs," Stanford University Publications, p. 44.

*Previous records.* From *Eriodictyon, Eriogonum* and other hosts in California.

*Lower California records.* From leaves of *Eriodictyon* sp. at Ensenada.

### **Pseudococcus filamentosus** (Ckll.).

Fig. 9.

*Previous records.* A widely distributed tropical species, occurring on various hosts.

*Lower California records.* From *Lysiloma* sp. ("palo blanco") at La Paz; undetermined mimosaceous shrub at San Antonio; *Cercidium* sp. on the beach at San Jose del Cabo.

*Habit.* The specimens from *Lysiloma* were found in cracks in the bark, while those from the other hosts were exposed upon the twigs. In all cases the insects are entirely enveloped in fluffy masses of sticky secretion.

*Morphological characteristics.* Length (on slide) 4 mm. Derm blue green. Cerarii present only on the last 6-7 abdominal segments, each with two cerarian spines and no auxiliary setae, except for two or three in the anal lobe cerarii, and with no grouped pores. Spines stout, conical, distinctly constricted at the base and, except in the last two cerarii, so widely separated that their identity is obscured. Dorsal body spines few, those on the abdomen arranged in a single transvere row on each seg-

ment, in form (Fig. 9A) resembling the cerarian spines, variable in size, those of the cephalic region noticeably more slender. Anal ring large, in some examples bearing as many as 15 setae of various lengths, in others but the normal 6 setae. Tubular ducts abundant, all small and without a raised rim about the mouth. Antennae (Fig. 9C) noticeably short, 6-7-segmented. Legs (Fig. 9D) short and stout, the claw without a tooth.

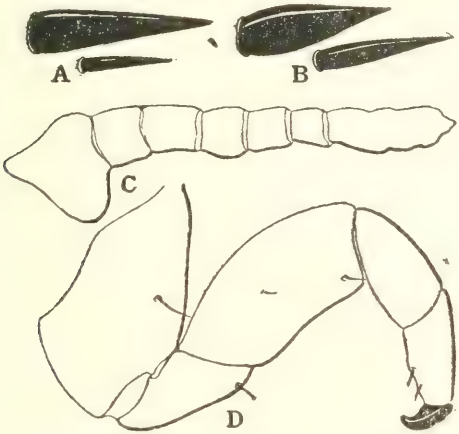


Fig. 9.—*Pseudococcus filamentosus* (Ckll.): A, types of spines from specimen from Hawaii; B, types of spines from specimen from *Lysiloma* in Lower California; C, antenna; D, leg.

Notes: The above description and the accompanying figures are from examples from *Lysiloma*. The Lower California examples differ somewhat from specimens from Hawaii in having the spines stouter and more distinctly constricted at the base (compare Figs. *9A* and *9B*, the former from Hawaiian examples), but there appear to be no other special differences. The presence of supplementary setae on the anal ring is unusual but seems to be extremely variable.

### **Pseudococcus maritimus** Ehrh.

1918. *Pseudococcus maritimus* (Ehrh.), Ferris: "California Species of Mealy Bugs," Stanford University Publications, p. 48, pl. 2, fig. 13.

*Previous records.* From many different hosts throughout the United States.

*Lower California records.* From *Tapirira edulis* ("ciruela") at Cabo San Lucas.

### **Pseudococcus salinus** (Ckll.).

1918. *Pseudococcus salinus* (Ckll.), Ferris: "California Species of Mealy Bugs," Stanford University Publications, p. 52, pl. 1, fig. 5.

*Previous records.* From *Distichlis spicata* in the San Francisco Bay region and at La Jolla, Calif.

*Lower California records.* From *Distichlis spicata* at La Paz.

Notes: These specimens agree quite closely with typical examples, except that the anal ring is perhaps not quite so far behind the anal lobe cerarii.

### **Pseudococcus sequoiae** (Coleman).

1918. *Pseudococcus sequoiae* (Coleman), Ferris: "California Species of Mealy Bugs," Stanford University Publications, p. 53, pl. 1, fig. 3.

*Previous records.* From *Sequoia* and various species of *Cupressus* in California.

*Lower California records.* From *Cupressus* sp. at Ensenada.

### **Pseudococcus virgatus** (Ckll.).

1919. *Pseudococcus virgatus* Ckll., Ferris: *Journal of Economic Entomology,* **12**: 297, fig. 17.

*Previous records.* A widely distributed tropical and subtropical species.

*Lower California records.* From aerial rootlets of *Ficus palmeri* in the canyon below San Bartolo.

## Genus **TRIONYMUS** Berg.

### **Trionymus smithii** (Essig).

1918. *Trionymus smithii* (Essig), Ferris: "California Species of Mealy Bugs," Stanford University Publications, p. 71, pl. 3, fig. 27.

*Previous records.* From various species of *Elymus* in California.

*Lower California records.* From *Chaetochloa caudata* at San Jose del Cabo.

### **Trionymus** sp.

A few specimens of a species of this genus were taken from beneath the bases of the leaves of yucca at Triunfo. These closely resemble examples from yucca in Arizona and it is possible that it is the species originally described by Cockerell as *Dactylopius olivaceous.*

## Genus **PHENACOCCUS** Ckll.

### **Phenacoccus helianthi** Ckll.

1919. *Phenacoccus helianthi* (Ckll.), Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 22.

*Previous records.* From various hosts in New Mexico.

*Lower California records.* From *Celosia floribunda* ("bledo") and *Cassia* sp. at Todos Santos, and *Elaphrium microphyllum* ("torote") at Cabo San Lucas.

### **Phenacoccus franseriae** n. sp.

Fig. 10.

*Type* from *Franseria* sp. at San Jose del Cabo. Also from *Hymenoclea monogyra* at the same place and *Encelia palmeri* at Todos Santos.

*Habit.* Of a rather greenish color, slightly dusted over with powdery secretion and with very short marginal tassels. Ovisac long and slender.

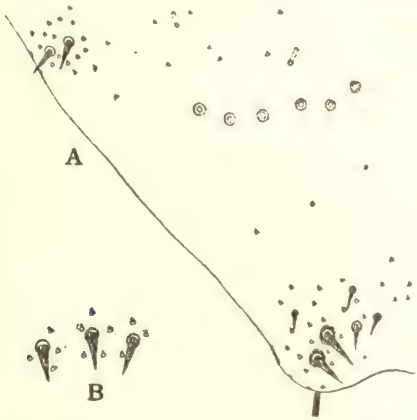


Fig. 10.—*Phenacoccus franseriae* n. sp.: A, anal and penultimate cerarii; B, group of spines from dorsum of abdomen.

*Morphological characteristics.* Adult female of the usual elongate oval form; length (flattened on slide) 4–4.25 mm. Eighteen pairs of cerarii present, these for the most part with but two cerarian spines, the anal pair, however (Fig. 10A), with three or four smaller spines and the first two or three cephalic pairs with three. All the cerarii without auxiliary setae and with few pores. Anal lobes without chitinization either dorsally or ventrally, the ventral side with two slender setae. Dorsal body setae few and very small except for a median group of three (Fig. 10B) on the penultimate and antepenultimate segments, these as large as the cerarian spines and accompanied by a cluster of pores. Ventral body setae quite long and slender, with a single isolated submarginal seta near each lateral margin of each abdominal segment. Derm of the dorsum beset with numerous small trilocular pores and an occasional small tubular duct, the three segments preceding the last each with a transverse row of multilocular pores along the posterior margin. Venter

with numerous trilocular pores and small tubular ducts and with many multilocular pores on the posterior portion of the abdomen. Anal ring setae about two-thirds as long as the anal lobe setae. Antennae 9-segmented.

Notes: This species is one of a group, including such forms as *P. colemani* and *P. cevalliae,* which are extremely difficult to separate. It differs from any similar form that I have seen in the presence of the median groups of spines on the dorsum of the abdomen.

### **Phenacoccus** sp.

A species very closely resembling the preceding, but differing in not possessing the dorsal group of spines, was taken from a species of *Phyllanthus* at La Laguna. I am not disposed to give it a name.

## Genus **PUTO** Sign.

### **Puto yuccae** (Coq.).

1918. *Puto yuccae* (Coq.), Ferris: "California Species of Mealy Bugs," Stanford University Publications, p. 64.

*Previous records.* A widely distributed species on many hosts throughout southwestern and western United States.

*Lower California records.* From *Atriplex* sp. at La Paz, and *Antigonum* ("flor de San Miguel") at San Antonio.

## Genus **ERIUM** Ckll.

### **Erium lichtensioides** (Ckll.).

1918. *Erium lichtensioides* (Ckll.), Ferris: "California Species of Mealy Bugs," Stanford University Publications, p. 75, pl. 3, fig. 25.

*Previous records.* Occurring throughout western United States on species of *Artemisia.*

*Lower California records.* From *Artemisia californica* at Ensenada.

## Genus **TACHARDIA.**

### **Tachardia** sp.

A species of this genus was found in some abundance on *Acacia flexicaulis* ("palo de fierro") at La Paz, San Pedro, and San Bartolo. The North American species of this group are all structurally almost identical, differing only in the form and color of the secretions, and until a careful review of all our species has been made attempts at identification are not likely to be very successful.

## Genus **ACLERDA** Sign.

### **Aclerda attenuata** n. sp.

Fig. 11.

*Type* from *Distichlis spicata* on the beach at the Eureka ranch near La Rivera. Also from bamboo or *Arundo* at the same place and at Todos Santos.

*Habit.* Concealed beneath the sheathing bases of the leaves.

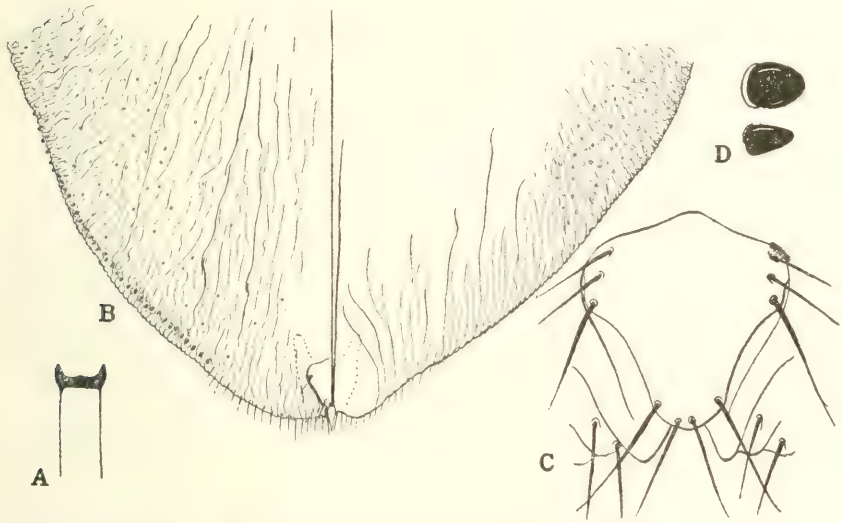


Fig. 11.—*Aclerda attenuata* n. sp.: A, type of duct; B, posterior portion of abdomen, left half dorsal, right half ventral; C, anal plate; D, types of marginal spines.

*Morphological characteristics.* Adult female varying greatly in length and width, the largest examples attaining a length of 7–9 mm. In the specimens from the type host (the stems of which are very slender) the body of the insect is usually much attenuated, while in those from the other host it is usually relatively much broader, although it is always distinctly elongate. In practically all of the specimens examined, the posterior extremity is turned to one side as in *Aclerda distorta* Green.

In old specimens the body becomes very heavily chitinized except the median and extreme anterior portions, but in immature examples of the last instar the chitinization is confined to the posterior portion of the abdomen. This posterior area (Fig. 11B) is beset both dorsally and ventrally with numerous shallow furrows. Margin of the body with a narrow zone of small, tubercle-like spines, some of which (Fig. 11D) are almost spherical, others somewhat elongate, this zone extending entirely about the margin of the body except for a short distance on each side of the

anal cleft, where the spines are replaced by short setae. The spines are accompanied by numerous tubular ducts of the type common to the genus (Fig. 11A), which are also quite abundant over the chitinized posterior portion of the abdomen, and within this zone is another of small, cylindrical ducts. Anal plate (Fig. 11C) entire, tapering and sometimes quite acute at the apex and bearing several setae as indicated in the figure. Anal ring cephalad of the anterior margin of the plate. Ventral furrow almost closed.

Notes: In many respects this species most closely resembles *Aclerda distorta* Green, but in the latter species the zone of tubercle-like spines is continuous to the margin of the anal cleft.

## Genus **PULVINARIA** Targ.

### **Pulvinaria peninsularis** n. sp.

Fig. 12.

*Type* from undetermined shrub at San Bartolo. Also from undetermined shrub at La Paz, *Philibertia tomentella* at San Jose del Cabo, *Nesaea salicifolia* between Cabo San Lucas and Pescadero, *Karwinskia humboldtiana* at Todos Santos, orange at San Bartolo, and *Celosia floribunda* at Miraflores.

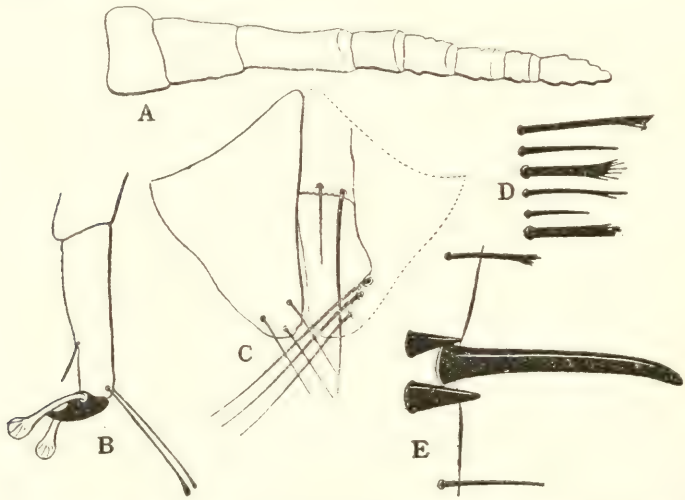


Fig. 12.—*Pulvinaria peninsularis* n. sp.: A, antenna; B, tarsus; C, anal plates; D, types of marginal spines; E, spines of stigmatic depression.

*Habit.* Adult female secreting a rather loose and quite slender ovisac from 5–8 mm. long, the insect becoming much shriveled at maturity.

*Morphological characteristics.* Length (on slide) 2–3 mm. Derm membranous throughout. Stigmatic depressions (Fig. 12E) with two

short, stout spines and a rather slender curved spine about four times as long. Marginal spines quite numerous, arranged in an irregularly single or double series, of various shapes and sizes. Some (Fig. 12D) are quite short and stout, flattened and frayed at the tip, others are longer, more slender and little or not at all frayed, and between these extremes are various intermediate forms. Anal plates (Fig. 12C) of normal form, each with three slender dorsal apical setae and three very long ventral subapical setae and with two pairs of fringe setae, the outer long and slender, reaching to the apex of the plates, the inner pair much shorter. Antennae (Fig. 12A) 8-segmented. Legs with the tarsus (Fig. 12B) broadly joined at the tibia.

Notes: This species most closely resembles *P. psidii* Maskell but in the latter species the marginal spines are practically all of the same length and are broadly flattened and much frayed at the tip.

## Genus **LICHTENSIA** Sign.

### **Lichtensia lycii** Ckll.

1919. *Lichtensia lycii* Ckll., Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 38, fig. 17.

*Previous records.* From *Lycium* in New Mexico.

*Lower California records.* From *Solanum* sp. near La Rivera and at Todos Santos and from *Lycium* sp. at San Jose del Cabo.

Notes: These specimens differ from New Mexican examples in their somewhat smaller size and in lacking the glazed appearance of the ovisac; structurally they appear to be identical.

## Genus **CEROPLASTES** Gray.

### **Ceroplastes cirripediformis** Comst.

*Previous records.* From southern United States, Mexico and West Indies, on various hosts.

*Lower California records.* From undetermined ornamental vine at La Paz.

Notes: I have not seen authentic specimens of *cirripediformis* but these examples agree quite closely with the various descriptions and figures of that species.

### **Ceroplastes irregularis** Ckll.

*Previous records.* From various species of *Atriplex* throughout southwestern United States.

*Lower California records.* From *Atriplex* sp. at La Paz.

Notes: These specimens agree structurally with typical examples of the species but have the secretionary covering very thin and dark brown with black apical markings.

## Genus **SAISSETIA** Dep.

### **Saissetia oleae** (Bern.).

*Previous records.* A widely distributed tropical and subtropical species.

*Lower California records.* From *Ficus palmeri* at San Bartolo, oleander at Miraflores, *Tapirira edulis* ("ciruela") at Todos Santos, and undetermined vine at La Paz.

### **Saissetia nigra** (Nietn.).

*Previous records.* A widely distributed tropical and subtropical species.

*Lower California records.* From undetermined species of *Ficus* at La Paz.

## Genus **TOUMEYELLA** Ckll.

### **Toumeyella cerifera** n. sp.

Fig. 13.

*Type* from *Albizzia occidentalis* ("palo escopeta") at Agua Caliente.

*Habit.* Found in deep cracks beneath loose bark under shelters built by an ant of the genus *Crematogaster*. Adult female secreting a distinct ovisac, high convex, broadly oval, length as much as 5 mm., height 3 mm.

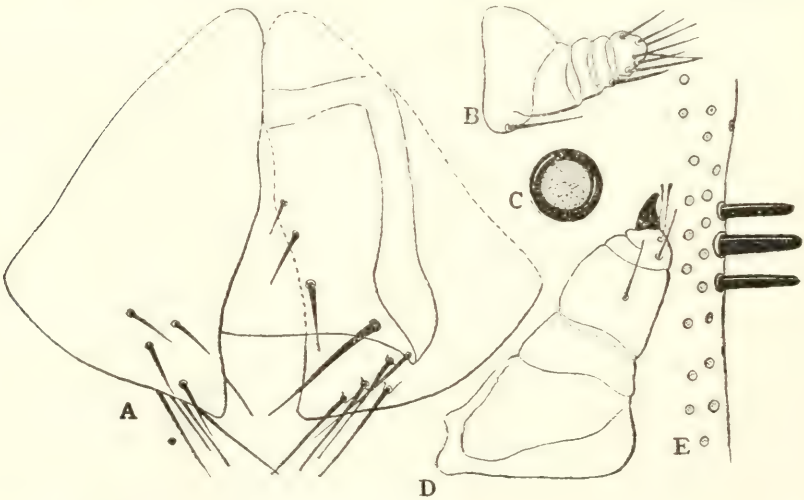


Fig. 13.—*Toumeyella cerifera* n. sp.: A, anal plates; B, antenna; C, type of dorsal pore; E, spines and pores of stigmatic depression; D, leg.

*Morphological characteristics.* Derm membranous throughout. Antennae (Fig. 13B) very short and stout, apparently 5-segmented, but the segmentation very obscure. Legs (Fig. 13D) likewise very short and stout. Marginal spines very few, small and slender. Stigmatic depressions (Fig. 13E) each with three short, stout spines of practically equal length and connected with the corresponding spiracles by a broad zone of pores. Anal plates (Fig. 13A) large, the cephalo-lateral margin much longer than the caudo-lateral margin. Each plate with four or five apical and subapical dorsal setae and with five ventral subapical setae. On each side there is a single stout fringe seta and there are several hypopygial setae. On the dorsum anterior to the anal plates are numerous pores of the type indicated in Fig. 13C.

Notes: In spite of the development of an ovisac this species is a *Toumeyella.*

### **Toumeyella mirabilis** Ckll.

1919. *Toumeyella mirabilis* Ckll., Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 44, fig. 21.

*Previous records.* From *Prosopis* in Arizona and Mexico.

*Lower California records.* From *Prosopis* sp. at La Paz.

Notes: The Lower California examples differ from typical specimens in having the dorsal white markings much larger, in some the white being so extensive that the insect is really white with black markings.

## Genus **PROTODIASPIS** Ckll.

### **Protodiaspis lagunae** n. sp.

Figs. 14, 15.

*Type* from *Quercus brandegeei* at Triunfo. Also from the same host at Santiago and La Laguna.

*Habit.* Occurring in crevices of the bark. Scale of female more or less circular, less than 1 mm. in diameter, variable in size and form in conformity with its environment, quite high convex, normally well formed, but in certain cases where the insect is deeply buried in a crack the scale is composed merely of loose threads. Scale of male elongate, white, non-carinate, with the exuvium at one end.

*Morphological characteristics.* Adult female .5–.6 mm. long, form rather broadly oval; derm membranous throughout except for a slight chitinization of the pygidium and sometimes of the anterior portion of the body. Pygidium (Fig. 14) with two pairs of weakly chitinized lobes which are frequently very obscure; with a few very minute and scattered dorsal ducts and with the circumgenital pores present in five groups

which in some specimens are nearly confluent, each group with about six pores. Anal opening close to the anterior end of the pygidium, surrounded by some chitinization but not by a heavy ring as in *P. parvula*.

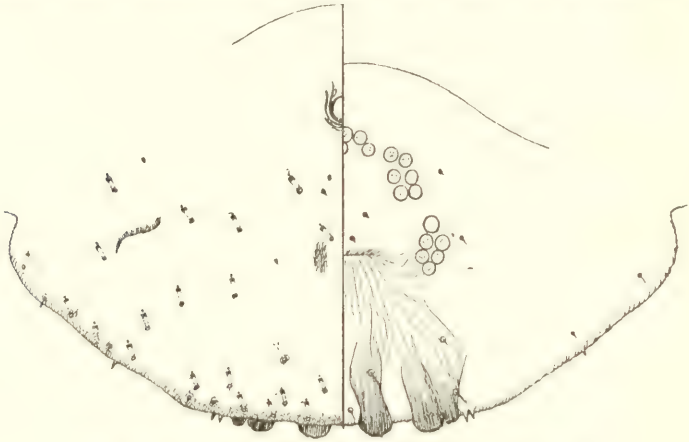

Fig. 14.—*Protodiaspis lagunae* n. sp.: pygidium.

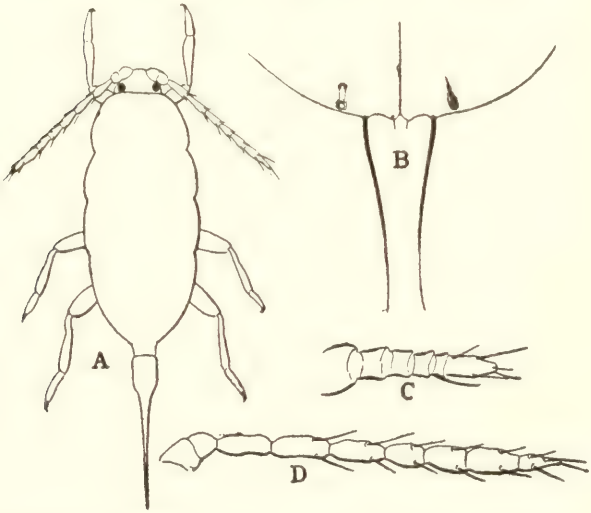


Fig. 15.—*Protodiaspis lagunae* n. sp.: A, adult male; B, pygidium of larva; C, antenna of larva; D, antenna of male.

Margin of the body anterior to the pygidium with a continuous single or double row of small gland spines.

Second stage (from exuvium) closely resembling the adult, but with very few dorsal ducts. The exuvium is shed in the normal manner by the pushing back of the ventral skin and does not at all enclose the adult.

First stage with the antennae (Fig. 15C) 5 or obscurely 6-segmented, the terminal segment short and not annulate. Apex of the abdomen (Fig. 15B) with the usual pair of long setae, with a pair of very small lobes which lie on the ventral side and do not reach beyond the margin and with a pair of large tubular, dorsal ducts.

Adult male (Fig. 15A) apterous, otherwise of the ordinary Diaspine type, the body terminating in a long style, the head with a dorsal and a ventral pair of ocelli, the body entirely hairless, the attennae (Fig. 15D) 9-segmented, very slightly clavate.

Notes: This differs from *P. lobata* Ferris and *P. parvula* Ckll. in the presence of the circumgenital pores and from *P. agrifoliae* Essig. in the presence of well developed lobes.

## Genus **ANCEPASPIS** Ferris.

### **Ancepaspis novemdentata** n. sp.

Fig. 16.

1920. *Ancepaspis* sp., Ferris: *Can. Ent.*, **52**:32.

*Type* from *Lysiloma* sp. ("palo blanco") at La Paz.

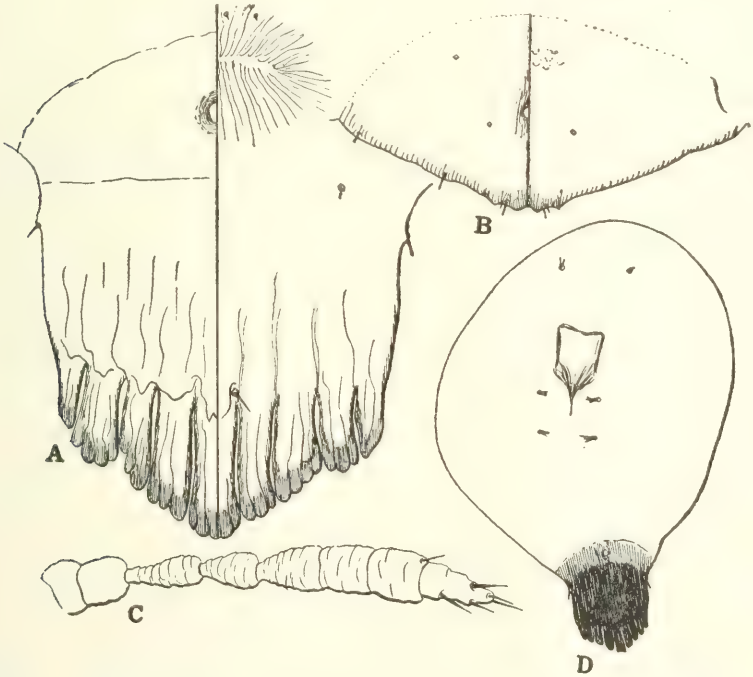


Fig. 16.—*Ancepaspis novemdentata* n. sp.: A, pygidium of adult female; B, pygidium of second stage; C, antenna of male; D, adult female removed from exuvium of second stage.

*Habit.* Occurring in cracks in the bark and about the buds. There is no scale, but a small amount of wax is secreted. The adult female is inclosed within the black, heavily chitinized second exuvium of the second stage. The male is inclosed within the hardened exuvium of the first stage, from the posterior extremity of which arises a very short secretionary scale.

*Morphological characteristics.* Adult female, when removed from the enclosing second exuvium, about .5 mm. long, irregularly oval in form (Fig. 16D), membranous throughout except for the heavily chitinized pygidium. Pygidium (Fig. 16A) terminating in nine quite long and slender lobes, the central one of which is somewhat the longest, the others successively slightly shorter. Anal opening near the anterior margin of the pygidium. Pores and ducts entirely lacking.

Second stage with the pygidium (Fig. 16B) without lobes, slightly acute at the apex.

First stage larva with the antennae short, 6-segmented, the terminal segment not elongate and not annulate; the pygidium without lobes or gland spines.

Adult male apterous but otherwise of the usual Diaspine type; the ocelli in a dorsal and ventral pair; the body terminating in a slender style, entirely hairless; antennae (Fig. 16C) 8-segmented, rather short and strongly clavate.

Notes: In my original description of the genus *Ancepaspis,* I stated that the male of this species had no secretionary scale, which is erroneous as there is a very small but still distinct amount of secretion. This species is probably most closely related to *A. tridentata* (Ferris).

### **Ancepaspis tridentata** (Ferris).

1919. *Protodiaspis tridentata,* Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 46, fig. 22.

1920. *Ancepaspis tridentata* (Ferris), Ferris: *Can. Ent.,* **52**:32.

*Previous records.* From *Prosopis velutina,* Arizona.

*Lower California records.* From *Prosopis* sp. at La Paz and several other points. It is very abundant in the area visited.

## Genus **XEROPHILASPIS** Ckll.

### **Xerophilaspis prosopidis** (Ckll.).

1919. *Xerophilaspis prosopidis* (Ckll.), Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 58, fig. 31.

*Previous records.* From *Prosopis* in Arizona and California.

*Lower California records.* From *Prosopis* at La Paz.

## Genus **DIASPIS** Costa.

### "Diaspis" arizonica Ckll.

1919. *"Diaspis" arizonica* Ckll., Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 49, fig. 24.

*Previous records.* From *Prosopis velutina,* Arizona.

*Lower California records.* From *Acacia flexicaulis* ("palo de fierro") and *Lysiloma sp.* ("palo blanco") at La Paz and an undetermined mimosaceous shrub at Triunfo.

### **Diaspis echinocacti** (Bouché).

*Previous records.* A native of the western hemisphere, but widely distributed in company with its hosts, the various species of cacti.

*Lower California records.* On *Pereskiopsis brandegeei* ("alcajer") at Agua Caliente.

### **Diaspis simmondsiae** n. sp.

Fig. 17.

*Type* from *Simmondsia californica* at La Paz. Also from the same host at La Rivera and Todos Santos.

*Habit.* Scale of the female of the type common to the genus, about 2 mm. in diameter. Scale of the male likewise of the type common to the genus but noncarinate; frequently the males occur massed in great numbers about a female, and in these cases the identity of the individual scales may be entirely lost, the whole group appearing as a mass of fluffy secretion.

*Morphological characteristics.* Adult female 1.25 mm. long, of the normal turbinate form, with the lateral margins of the abdominal segments projecting but little; membranous except for the pygidium.

Pygidium (Fig. 17A) relatively large, with the median lobes (Fig. 17B) set in a depression, diverging sharply and with their margins minutely serrate. Second pair of lobes small, but quite prominent, obscurely bilobed. Third pair of lobes very small and low. Beyond the third lobes are numerous small gland spines arranged singly. Tubular ducts very numerous and very small, scattered. Marginal ducts somewhat larger than those of the dorsum, arranged as indicated in the figure. Anal opening well toward the posterior margin. Ventral side apparently without tubular ducts. Circumgenital pores in five groups with 6–12 pores in each. Margins of abdominal segments with many small ducts,

but only the last segment anterior to the pygidium with gland spines. Dorsum with submedian groups of ducts.

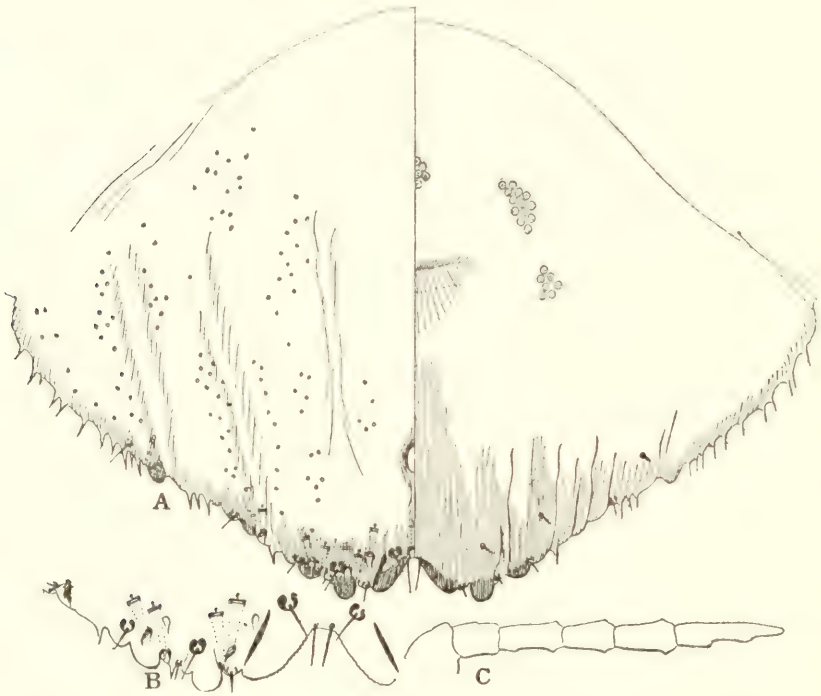


Fig. 17.—*Diaspis simmondsiae* n. sp.: A, pygidium; B, margin of pygidium; C, antenna of first stage.

Second stage closely resembling the adult, but with very few ducts.

First stage with the antennae (Fig. 17C) 6-segmented, the terminal segment not annulate but slightly elongate. Pygidium without lobes.

Notes: This species is one of a group to which belong such forms as *Diaspis texensis* Ckll., *D. manzanitae* (Whit.), and *D. toumeyi* Ckll.

## Genus PSEUDODIASPIS Ckll.

1897. Cockerell: *Bulletin 6*, t. s., Division of Entomology, Department of Agriculture, p. 21.

1919. Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 52.

Considering only the type species and one other (*P. elaphrii* n. sp.) which I believe to be strictly congeneric, I should define this genus as follows:

Diaspine Coccidae referable by the character of the tubular ducts to the *Diaspis* series; with more or less conspicuous paraphyses at the bases of the lobes, the lateral lobes not bilobed; with the dorsal ducts few, not arranged in definite transverse rows; with the microducts very long and slender; with the circumgenital pores present or absent; gland spines few or lacking; the scale of the female more or less circular with the exuviae subcentral, exuviation occurring by the pushing back of the ventral derm; scale of the male somewhat elongate, with the exuvium at one end, the texture as in the female.

This definition, however, will exclude certain species now referred to the genus and for which there appears to be no other available. Therefore, rather than name a new genus in a group where practically none of the existing genera are at all definitely limited, I prefer to extend the definition of the genus to include these and certain other forms. Upon this basis I understand the genus to include certain forms belonging to the *Diaspis* series, in which the scale of the female is circular and that of the male somewhat elongate but resembling that of the female in texture; the circumgenital pores either lacking or if present the pygidium with paraphyses; the gland spines few or lacking; the dorsal ducts for the most part few, although at times abundant, but never arranged in sharply marked transverse rows, the lobes never bilobed; the microducts usually very long.

As thus understood, the genus (including certain species here described as new) contains ten species all of which are natives of southwestern United States and Mexico. It is in all probability a highly artificial group, but withal less so than the majority of the so-called genera of the Diaspinae.

### **Pseudodiaspis larreae** (Ckll.).

Figs. 18, 19

1897. *Aspidiotus (Pseudodiaspis) larreae* Ckll., *Bulletin 6*, t. s., Division of Entomology, Department of Agriculture, p. 21.

*Type* from *Covillea glutinosa* (= *Larrea tridentata*), Yuma, Ariz.

*Habit.* " . . . Scale about 2 mm. diameter, flat, irregular, round to suboval, dull white with a slightly creamy tint; exuviae not visible in the mature scale, but in younger scales the elongate-oval, pale straw-colored first skin is exposed, sublateral or even quite lateral. . . . Male scale small, elongate, mytiliform, white, with the elongate first skin projecting at the small end like a *Mytilaspis*. . . ."

*Morphological characteristics.* Adult female (Fig. 18) about 2 mm. long, of the usual turbinate form, the cephalothorax quite heavily chitin-

ized and occupying the greater part of the body. Margins of the abdominal segments with small ducts but without gland spines. Dorsum of the abdomen with a few small ducts, the arrangement of which is not determinable in the specimens at hand.

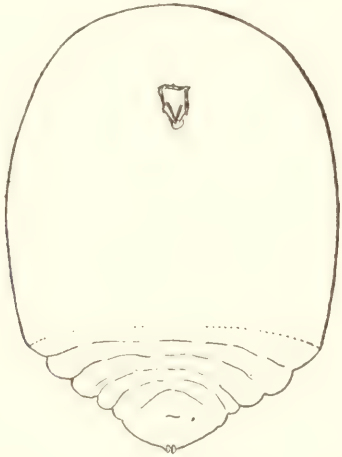

Fig. 18.—*Pseudodiaspis larreae* Ckll.: adult female.

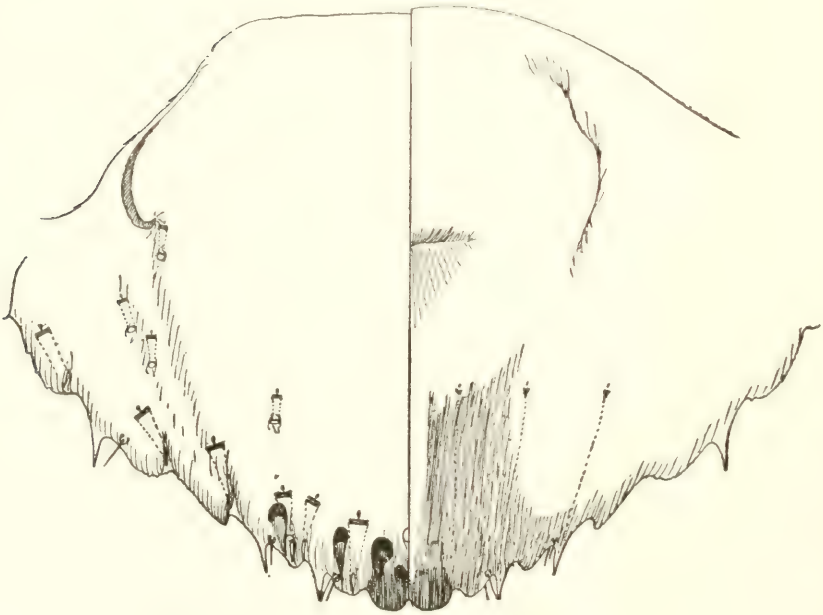

Fig 19.—*Pseudodiaspis larreae* Ckll.: pygidium.

Pygidium (Fig. 19) quite large, with the median lobes alone developed, these broad, low, rounded at the apex and close together. A short, club-like paraphysis extends into the pygidium from the base of each lobe. Beyond the first lobes is a gland pore followed by a slender paraphysis, a small spine, a small gland spine, two gland pores, a spine, a gland spine, two deep and quite widely separated notches with a pore at the base, a spine, a gland spine and another slight notch with a pore. The inner extremity of the paraphyses is heavily chitinized, presenting a lunate form. Marginal tubular ducts quite large, their pores without a chitinized rim. Dorsal ducts very few, smaller than those of the margin. On each side there are three or four long, slender microducts. Anal opening very small, close to the apex of the pygidium. Ventral side apparently without ducts or pores.

Notes: The above description is based upon a single specimen from the type lot, received through the kindness of Professor Cockerell. The species has not been recorded from Lower California but it undoubtedly occurs on the peninsula and I take this opportunity of redescribing it. The available specimen is in very poor condition for study and it is possible that the examination of more material will require some modifications in the description.

### **Pseudodiaspis elaphrii** n. sp.

Figs. 20, 21.

*Type* from *Elaphrium microphyllum* ("torote") at Cabo San Lucas.

*Habit.* Found on the bark of the host. Scale of the female about 2 mm. in diameter, circular, flat, gray, with the exuviae central and entirely covered by secretion; ventral scale lacking. Scale of male not observed.

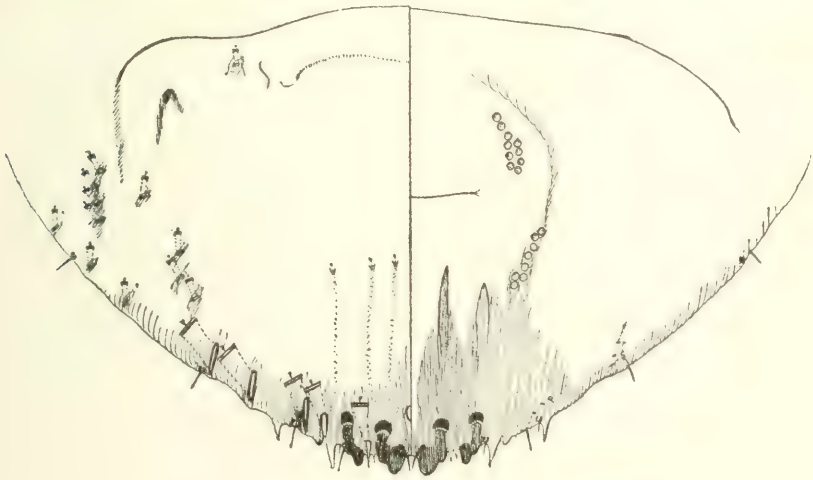

Fig. 20.—*Pseudodiaspis elaphrii* n. sp.: pygidium.

*Morphological characteristics.* Adult female (Fig. 21A) about 1 mm. long, somewhat elongate, the cephalothorax expanded and somewhat wider than the abdomen, from which it is separated by a constriction. Anterior portion of the cephalothorax tending to be quite heavily chitinized at maturity, the remainder of the body, except for the pygidium, membranous. Dorsum with pores only at the margins of the abdominal segments.

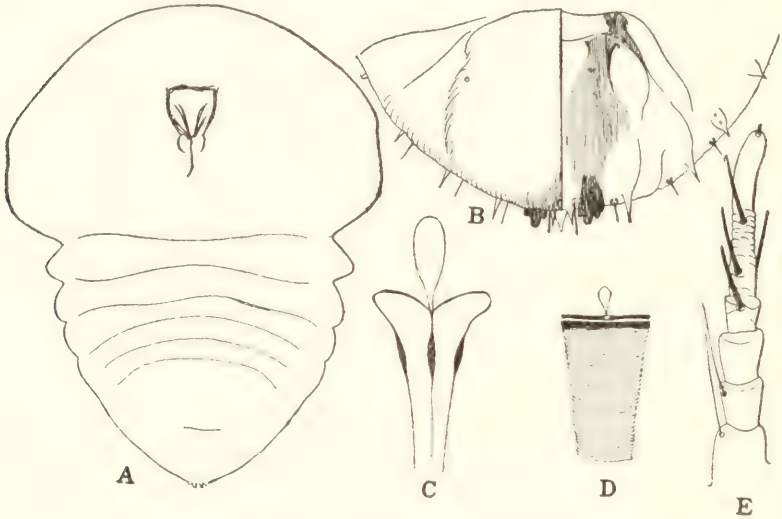


Fig. 21.—*Pseudodiaspis elaphrii* n. sp.: A, adult female; B, pygidium of first stage; C, extremity of microduct; D, duct; E, antenna of first stage.

Pygidium (Fig. 20) relatively large, with two pairs of rather small lobes. Median lobes slightly separated, acute at the apex, with a deep lateral notch and continuous with a conspicuous, club-shaped paraphysis. Between the median and second lobes is a small pore prominence. Second lobes resembling the first in form but slightly smaller, likewise continuous with a club-shaped paraphysis, the paraphyses of both pairs having their inner extremity heavily chitinized and of lunate form. Beyond the second lobes is a spine followed by a gland spine, two pores, a spine, a gland spine, two pores and two widely separated spines. Marginal ducts large, their pores surrounded by chitinous rims; dorsal ducts much smaller than those of the margin, very few. All the ducts presenting a transversely striate appearance (Fig. 21D). On each side there are three or four pairs of long, slender microducts with the apex of the form shown in Fig. 21C. Anal opening very small, close to apex. Ventral side with a few very minute ducts. Circumgenital pores present in four groups, each with about 10 pores.

Second stage with pygidium as in the adult except for the almost entire absence of dorsal ducts.

First stage with the antennae (Fig. 21E) 5-segmented, the terminal segment somewhat elongate and slightly annulate; pygidium (Fig. 21B) with a single pair of rather large lobes and with several small gland spines.

Notes: In spite of the presence of circumgenital pores I regard this species as strictly congeneric with *P. larreae*.

### **Pseudodiaspis multipora** Ferris.

1919. *Pseudodiaspis multipora* Ferris, *Ent. News*, **30**:275.

*Previous records.* From *Phoradendron flavescens* on oak in southern California.

*Lower California records.* Abundant on mistletoe on *Cercidium* throughout the area visited.

Notes: In the original description (which was based upon but two specimens) it was stated that the derm was membranous throughout. The examination of more material shows that the cephalothorax tends to become quite heavily chitinized at maturity.

### **Pseudodiaspis yuccae** (Ckll.).

1919. *Pseudodiaspis parkinsoniae* (Ckll.), Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," p. 56, fig. 30.
1920. *Pseudodiaspis yuccae* (Ckll.), Ferris: *Can. Ent.*, **52**:64.

*Previous records.* From *Yucca, Celtis, Acacia,* and *Cercidium* (= *Parkinsonia*) in southwestern United States.

*Lower California records.* From *Cercidium* sp. at San Antonio, *Celosia floribunda* ("bledo") at San Bartolo and Miraflores, and *Simmondsia californica* at La Rivera.

### **Pseudodiaspis ruelliae** n. sp.

Fig. 22.

*Type* from *Ruellia* sp. ("rama prieta") at Cabo San Lucas. Also from the same host at Todos Santos.

*Habit.* Occurring on the leaves associated with a curling that is probably due to the presence of the insect. Scale of the female circular, about .75 mm. in diameter, slightly convex and of a distinctly yellowish color; exuviae subcentral, the first naked, the second covered with secretion; ventral scale quite thick. Scale of male white, elongate with an obscure median carina and with the exuvium at one end. Frequently many males are to be found massed about a female, and in this case many long, curling threads of wax arise from the mass.

*Morphological characteristics.* Adult female 1 mm. long, of the usual turbinate form, the thorax not separated from the abdomen by a

constriction, the abdominal segments projecting but little at the margins. Cephalothorax quite heavily chitinized cephalad of the mouthparts. Margins of the abdominal segments with at the most a few very minute gland spines and with numerous small ducts. Dorsum with a submedian group of small ducts on each side of each abdominal segment.

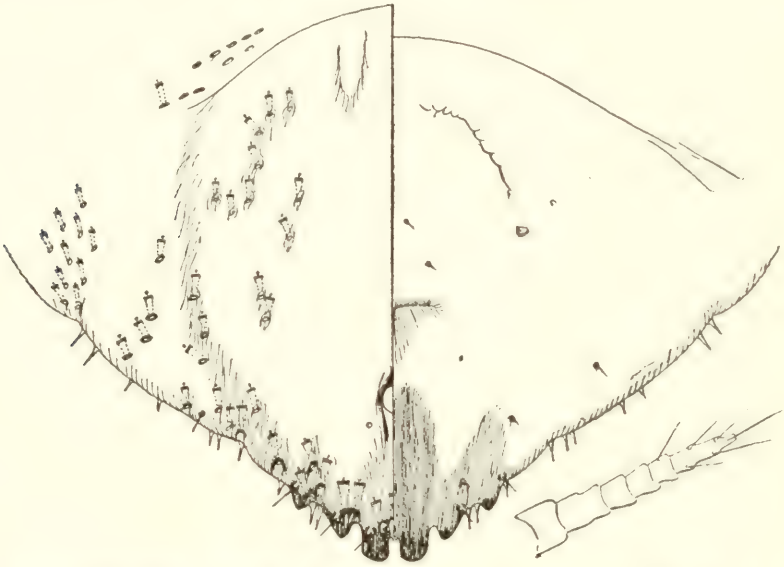

Fig. 22.—*Pseudosiaspis ruelliae* n. sp.: pygidium of adult and antenna of first stage.

Pygidium (Fig. 22) rather acute at the apex. Median lobes quite large, prominent, straight and with their apices nearly truncate. Second and third pairs consisting merely of an acute prominence. Between the second and third lobes are two small gland spines and beyond the third lobes a series of such spines arranged singly. Dorsal ducts rather few, somewhat smaller than those of the margin, the arrangement as indicated in the figure. Microducts very minute and short. Anal opening moderately large, about one-fourth of the length of the pygidium from its apex. Ventral side apparently without tubular ducts. Circumgenital pores lacking.

Second stage with the pygidium very closely resembling that of the adult, differing only in having very few ducts.

First stage larva with the antennae (Fig. 22) 6-segmented, the terminal segment neither elongate nor annulate. Pygidium with a single pair of very small lobes.

Notes: I know of no species that this closely resembles.

**Pseudodiaspis magna** n. sp.

Figs. 23, 24, 25, 26B.

*Type* from an undetermined shrub on the beach at La Paz.

*Habit.* Occurring on the stem and twigs of the host. Scale of the female 3.5–4 mm. in diameter, nearly circular, flat, white or gray and of very firm texture; exuviae submarginal, the first naked, the second normally covered with secretion. Scale of male resembling that of the female in color and texture, slightly elongate with the exuvium at one end.

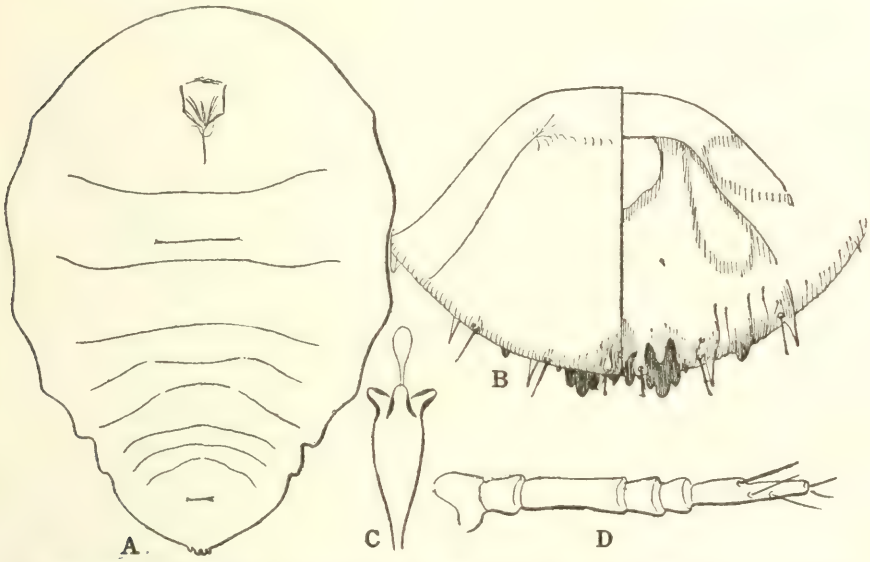


Fig. 23.—*Pseudodiaspis magna* n. sp.: A, adult female; B, pygidium of first stage; C, extremity of microduct; D, antenna of first stage.

*Morphological characteristics.* Adult female (Fig. 23A) 2.5 mm. long, form somewhat elongate, the cephalothorax not separated from the abdomen by a constriction. Derm at maturity everywhere heavily chitinized. Abdominal segments with at the most a single gland spine, but with many small ducts at each lateral margin and with submedian groups of ducts on the dorsum.

Pygidium (Fig. 24) large and heavily chitinized, with two pairs of lobes which, relatively to the rest of the pygidium, are very small. Median pair (Fig. 26B) rather widely separated, their mesal margins diverging somewhat, the apex deeply notched. Second pair much smaller than the first, tooth-like. Between the first and second pairs is

a small gland prominence, beyond the second pair a large spine, followed by a large gland spine, a prominence that perhaps represents the third lobe, a spine, a large gland spine, and at wide intervals two more spines followed by a single gland spine. The lobes and the margin, including the mouths of the submarginal pores, are very heavily chitinized. Marginal ducts quite short and stout, somewhat larger than those of the

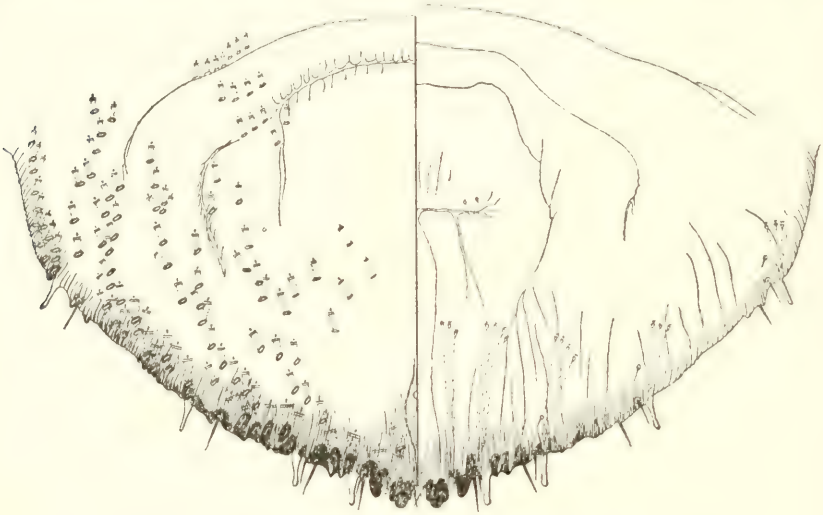

Fig. 24.—*Pseudodiaspis magna* n. sp.: pygidium of adult.

dorsum which are numerous and arranged in irregular rows as indicated in the figure. Microducts, opening at the apices of the gland spines, numerous, long and slender, the apices of the ducts of the type indicated in Fig. 21C. Anal opening small, placed well toward the apex of the pygidium. Ventral side apparently without tubular ducts. Circumgenital pores lacking.

Second stage with the pygidium (Fig. 25) with the lobes as in the adult but with practically no dorsal ducts.

First stage, with the antennae (Fig. 23D) 6-segmented, the terminal segment neither elongate nor annulate, the third segment noticeably long; pygidium (Fig. 23B) with a pair of large, toothed lobes and between these a pair of very small simple lobes.

Notes: This species is evidently quite close to *P. dentilobis* Ckll., the description of which follows, but it is apparently distinct. The two species differ chiefly in the form of the lobes (compare Fig. *26B* and *26C*) the lobes in *dentilobis* being distinctly truncate while in *magna* they are acute. Also the marginal ducts of *dentilobis* are noticeably longer and more slender.

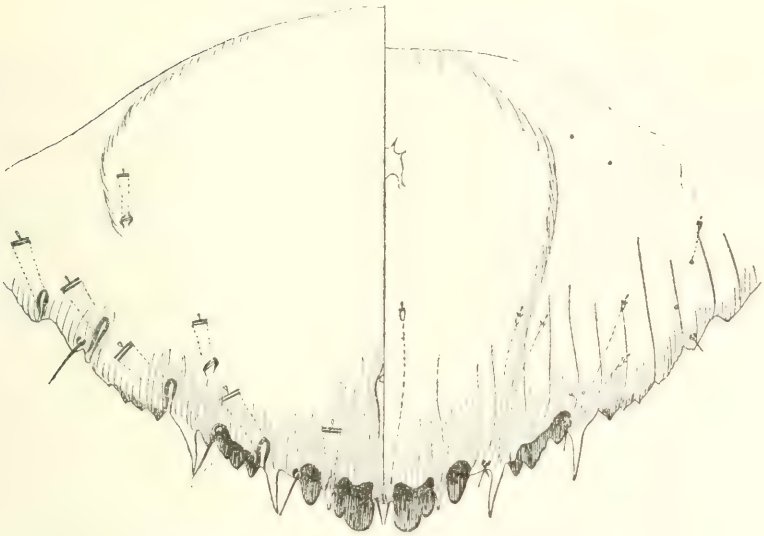

Fig. 25.—*Pseudodiaspis magna* n. sp.: pygidium of second stage.

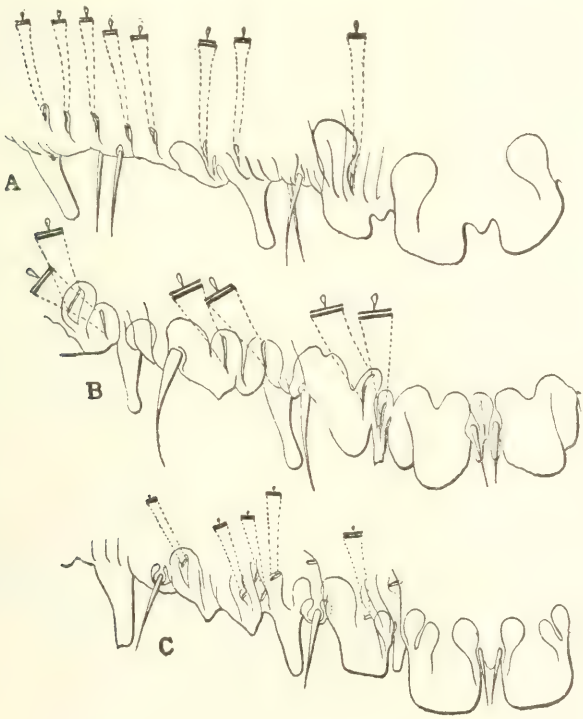


Fig. 26.—Margin of pygidium of: A, *Pseudodiaspis prosopidis* n. sp.: B, *Pseudodiaspis magna* n. sp.: C, *Pseudodiaspis dentilobis* Ckll.

### **Pseudodiaspis dentilobis** Ckll.

Fig. 26C.

1898. *Aspidiotus (Pseudodiaspis) dentilobis* Ckll., *Ann. Mag. Nat. Hist.*, (7) **1**:438.

*Type* from undetermined host and from *Acacia* and *Mimosa* at Cuatla, Mexico.

*Habit.* Scale of the female about 2 mm. in greatest diameter, slightly oval, moderately convex, gray or blackish; exuviae submarginal, the first bare, the second normally covered with secretion. Scale of male resembling that of the female in color and texture but distinctly elongate with the exuvium at one end.

*Morphological characteristics.* This species is very similar to *P. magna* described above. The form of the body and the general characters of the pygidium are practically identical but there is a distinct difference in the shape of the lobes, those of *dentilobis* (Fig. 26C) having the lateral margins parallel and the tips distinctly truncate. Also the ducts of *dentilobis* are much more slender than in *magna*. The first stage is identical with that of *magna*.

Notes: This species has not been taken in Lower California but I am including it because of its close relationship with *P. magna* and in order to make the discussion of this genus more complete. The above notes and the accompanying figure are based upon specimens labeled as from "Mimosa, Cuatla, Mexico," received from O. E. Bremner, and probably to be regarded as type material.

### **Pseudodiaspis prosopidis** n. sp.

Figs. 26A, 27, 28.

*Type* from *Prosopis* sp. at La Paz. Also taken from the same host at other places in the area visited.

*Habit.* Scale of the female 2.5–3 mm. in diameter, circular, flat, white, thick and firm; exuviae submarginal covered with secretion; ventral scale developed only about the margin but quite thick. Scale of male elongate, with exuvium at one end, in color resembling that of the female.

*Morphological characteristics.* Adult female (Fig. 27A) about 2 mm. long; general form somewhat elongate oval; derm at maturity heavily chitinized. Lateral margins of the abdominal segments projecting but little, with numerous pores but with no gland spines. Dorsum of the abdomen with numerous small ducts along the posterior margins of the segments except for a rather wide median area.

Pygidium (Fig. 28) with two pairs of prominent lobes with nearly parallel sides and with their apices somewhat sloping; each lobe continuous at its base with a club-shaped paraphysis. Beyond the second

lobe (Fig. 26A) is a large spine, followed by a large gland spine, and at wide intervals another spine, a gland spine, a spine and a cluster of three or four gland spines of which one is much larger than the others. Tubular ducts rather small and slender, the submarginal ducts very numerous and not larger than the dorsal ducts, the latter rather few and

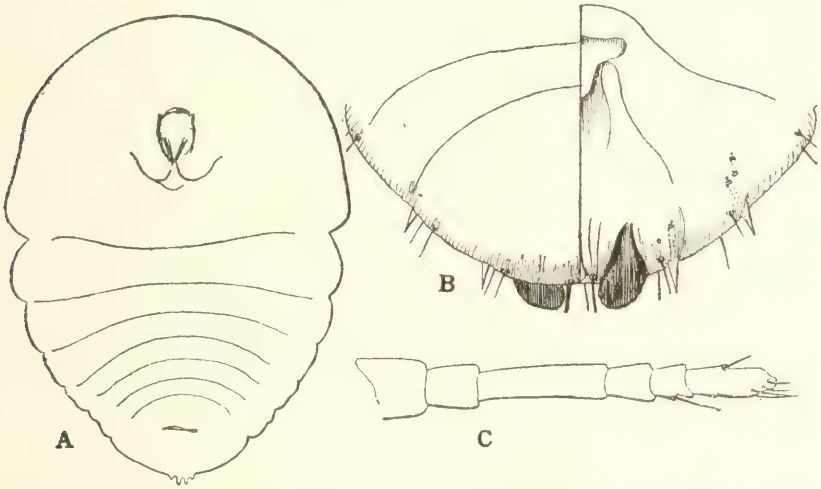


Fig. 27.—*Pseudodiaspis prosopidis* n. sp.: A, adult female; B, pygidium of first stage; C, antenna of first stage.

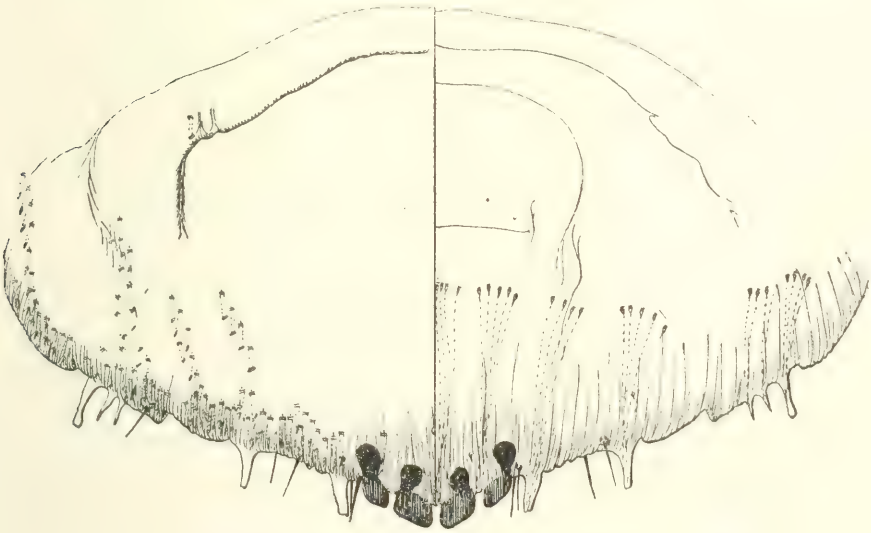

Fig. 28.—*Pseudodiaspis prosopidis* n. sp.: pygidium of adult.

arranged in fairly definite rows as indicated in the figure. Microducts, opening at the apices of the gland spines, abundant, long and slender. Anal opening very small, quite close to the apex of the pygidium. Ventral side apparently without tubular ducts. Circumgenital pores lacking.

Satisfactory preparations of the second stage not seen.

First stage with the antennae (Fig. 27C) rather slender, the terminal segment neither elongate nor annulate, the third segment rather long. Pygidium (Fig. 27B) with a single pair of large, prominent, rounded lobes.

Notes: This species appears to be rather closely related to *P. magna* and *P. dentilobis* but differs most conspicuously in the presence of paraphyses at the bases of the lobes.

## Genus **PSEUDOPARLATORIA** Ckll.

### **Pseudoparlatoria parlatorioides** (Comst.).

Figs. 29, 30.

*Previous records.* A rather common species in the tropical and subtropical parts of the Western Hemisphere.

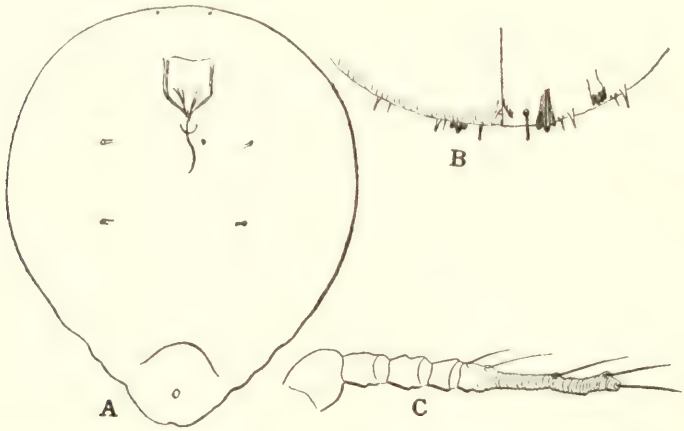


Fig. 29.—*Pseudoparlatoria parlatorioides* (Comst.): A, adult female; B, pygidium of first stage; C, antenna of first stage.

*Lower California records.* From oleander and an undetermined ornamental at La Paz; *Forchammeria watsoni* ("palo de San Juan") at La Rivera; *Cercidium* sp. at Agua Caliente; *Asclepias subulata,* banana and guava at San Jose del Cabo; *Celosia floribunda* ("bledo") and *Elaphrium microphyllum* ("torote") at Cabo San Lucas; avocado at Todos Santos.

The accompanying figures will supplement the original description. I may note that there is some variation in the number of groups of circumgenital pores, there being at times five groups. In the first stage

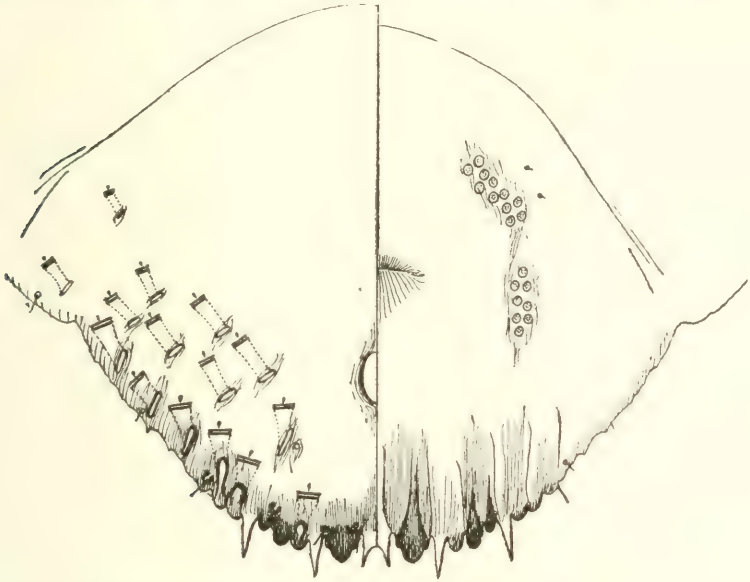

Fig. 30.—*Pseudoparlatoria parlatorioides* (Comst.): pygidium of adult.

larva the antennae are 5-segmented (Fig. 29C), the terminal segment long and distinctly annulate as in the typical Aspidiotine forms, although the species certainly belongs in the *Diaspis* series. The pygidium of the first stage (Fig. 29B) bears two pairs of small, notched lobes.

## Genus **CHIONASPIS** Sign.

### **Chionaspis distichlii** n. sp.

Fig. 31.

*Type* from *Distichlis spicata* along the beach at the Eureka ranch near La Rivera.

*Habit.* Occurring on the upper side of the leaves. Scale of female of the form usual to the genus, quite narrow, about 1 mm. long, the first exuvium naked, the second covered with secretion. Scale of male but little shorter than that of the female, non-carinate.

*Morphological characteristics.* Adult female about .75 mm. long, the derm membranous throughout except for the pygidium; the margins of the abdominal segments projecting but little, with numerous small ducts but without gland spines except on the first segment anterior to the pygidium. Dorsum of the abdomen with a few very small ducts.

Pygidium (Fig. 31) with three pairs of lobes, the median pair alone well developed, these simple and rounded at the tip, the second and third pairs very small, simple and scarcely projecting beyond the margin.

Fig. 31.—*Chionaspis distichlii* n. sp.: pygidium of adult.

Near the base of each lobe is a pair of quite large gland spines and between the third pair and the anterior margin of the pygidium is a single gland spine. The marginal and submarginal ducts are quite large, those of the dorsum for the most part smaller, all very few, their arrangement as indicated in the figure. Anal opening quite large, somewhat in advance of the center of the pygidium. Microducts all very minute. Ventral side with three rows of very small tubular ducts and with three or four pairs of quite large spines at some distance from the margin. Circumgenital pores in three groups of 10–15 pores.

Second stage closely resembling the adult except for the absence of all but the marginal ducts.

First stage with the antennae 6-segmented, all the segments very short except the first and sixth which are slightly elongate, the latter not annulate. Pygidium without lobes but with two or three pairs of gland spines.

Notes: This species is a member of a rather characteristic grass-infesting group to which belong such forms as *C. spartinae*. From this, the only American member of the group, it differs in the inconspicuous lobes and the small number of dorsal ducts.

**Chionaspis pinifoliae** (Fitch).

*Previous records.* Widely distributed throughout the United States on various conifers.

*Lower California records.* From *Pinus cembroides* at La Laguna.

**Chionaspis quercus** Comst.

*Previous records.* Widely distributed throughout the United States on various species of oaks.

*Lower California records.* From *Quercus brandegeei* at Triunfo, Santiago and La Laguna.

## Genus **LEPIDOSAPHES**

**Lepidosaphes acuta** n. sp.

Figs. 32, 33.

*Type* from an undetermined shrub at Cabo San Lucas.

*Habit.* Occurring on the twigs. Scale of the female of the type common to the genus, white, about 2.5 mm. long, the exuviae covered with secretion. Scale of male resembling that of female in form and texture.

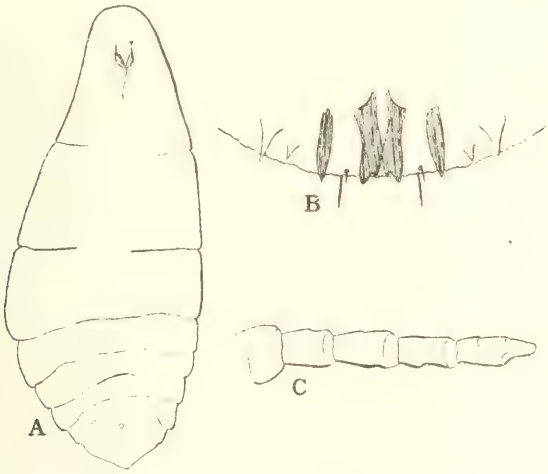


Fig. 32.—*Lepidosaphes acuta* n. sp.: A, adult female; B, pygidial margin of first stage; C, antenna of first stage.

*Morphological characteristics.* Adult female (Fig. 32A) about 2 mm. long, the derm tending to be quite heavily chitinized, especially on the cephalothorax. Cephalothorax elongate, with faint intersegmental constrictions, not sharply separated from the abdomen. Margins of the

abdominal segments not projecting, without gland spines but with a few small ducts.

Fig. 33.—*Lepidosaphes acuta* n. sp.: pygidium of adult.

Pygidium (Fig. 33) acute at apex, terminating in a pair of rather small, pointed median lobes, which are notched on the lateral margin. Second pair of lobes but little more than tooth-like projections which are somewhat bilobed. Gland spines entirely lacking. Tubular ducts quite numerous, scattered, all rather small, those of the dorsum as large as those of the margin, their distribution as indicated in the figure. Anal opening quite large, close to the anterior margin of the pygidium. Ventral side apparently without tubular ducts. Circumgenital pores lacking.

Second stage closely resembling the adult, but with fewer ducts.

First stage with the antennae (Fig. 32C) 5-segmented, the terminal segment short and not annulate. Pygidium (Fig. 32B) with two pairs of lobes.

Notes: This species is certainly not congeneric with the type of *Lepidosaphes,* but I refer it here for the present. I know of no other species that it at all closely resembles.

### **Lepidosaphes calcarata** n. sp.

Figs. 34, 35.

*Type* from *Haematoxylon boreale* ("palo de brazil") at La Paz. Also from *Acacia flexicaulis* ("palo de fierro") at La Paz; *Cassia occidentalis* ("palo de zorillo") and *Lysiloma* sp. ("palo blanco"), at Miraflores.

*Habit.* Occurring on the trunk and limbs. Scale of female of the type common to the genus, about 2.5 mm. long, quite broad posteriorly, sometimes strongly curved; exuviae naked, yellow. Scale of male not observed.

Fig. 34.—*Lepidosaphes calcarata* n. sp.: pygidium of adult.

*Morphological characteristics.* Adult female (Fig. 35A) about 2 mm. long, the derm membranous throughout or with the cephalothorax tending to be somewhat chitinized. Cephalothorax not divided by intersegmental constrictions and not sharply separated from the abdomen. Margins of the abdominal segments projecting somewhat, each with several small ducts, several gland spines and with a rather conspicuous chitinous spur (Fig. 35C) which bears one or two ducts which open near the apex.

Pygidium (Fig. 34) somewhat acute, with two pairs of lobes. Median lobes prominent, close together, their apices sloping and crenulate. Second lobes of the same shape as the first but smaller, not bilobed. Between the first and second lobes are two very small gland spines and at the base of the second lobe there is at each angle a large pore with a heavily chitinized rim. Beyond the second lobe are two large gland spines followed by three large pores with chitinous rims, a spine, two large gland spines, a large pore, three gland spines and a spur. Dorsal ducts somewhat smaller than those of the margin, arranged in rather definite rows as indicated in the figure. Microducts very small. Anal

opening somewhat cephalad of the center of the pygidium. Ventral side with two or three rows of very small ducts. Circumgenital pores lacking.

Second stage closely resembling the adult but with few ducts.

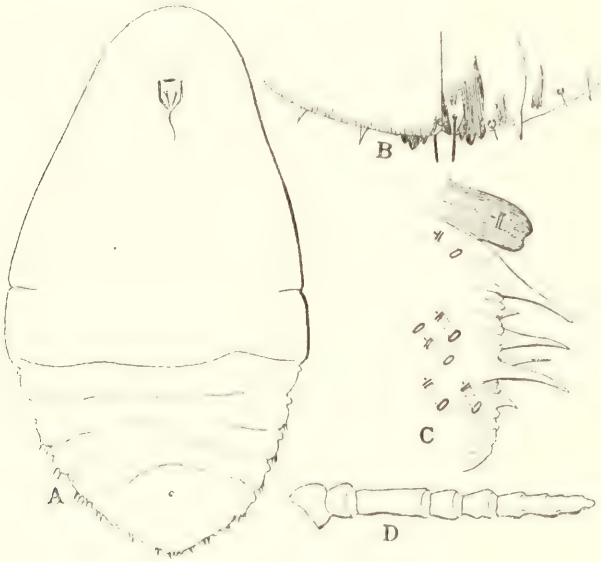


Fig. 35.—*Lepidosaphes calcarata* n. sp.: A, adult female; B, pygidial margin of first stage; C, lateral margin of an abdominal segment of adult female; D, antenna of first stage.

First stage with the antennae (Fig. 35D) 6-segmented, the terminal segment neither elongate nor annulate. Pygidium (Fig. 35B) with the lobes well developed, the median pair very small, almost fused, the second pair quite large and with the tip twice notched, the third and fourth pairs like the second but very small.

Notes: This species, like the preceding, is not a *Lepidosaphes* and is merely referred to this genus temporarily. I know of no species that closely resembles it.

### Lepidosaphes concolor (Ckll.).

1919. *Lepidosaphes concolor* (Ckll.), Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 60, fig. 33.

*Previous records.* From *Atriplex* in Texas, New Mexico and California.

*Lower California Records.* From *Encelia farinosa* and *Franseria* sp. at Todos Santos, and *Pedilanthus macrocarpa* ("candelilla") near Pescadero.

Notes: The specimens from these hosts agree very closely with typical examples.

**Lepidosaphes gloveri** (Pack.).

*Previous records.* A widely distributed tropical and subtropical species infesting citrus fruits.

*Lower California records.* From orange at San Bartolo.

**Lepidosaphes mimosarum** (Ckll.).

Fig. 36

1903. *Mytilaspis mimosarum* Ckll., *Entomologist,* **36**:45.

*Previous records.* From *Mimosa* sp., Zapotlan, Mexico.

*Lower California records.* On *Mimosa* sp., at San Pedro.

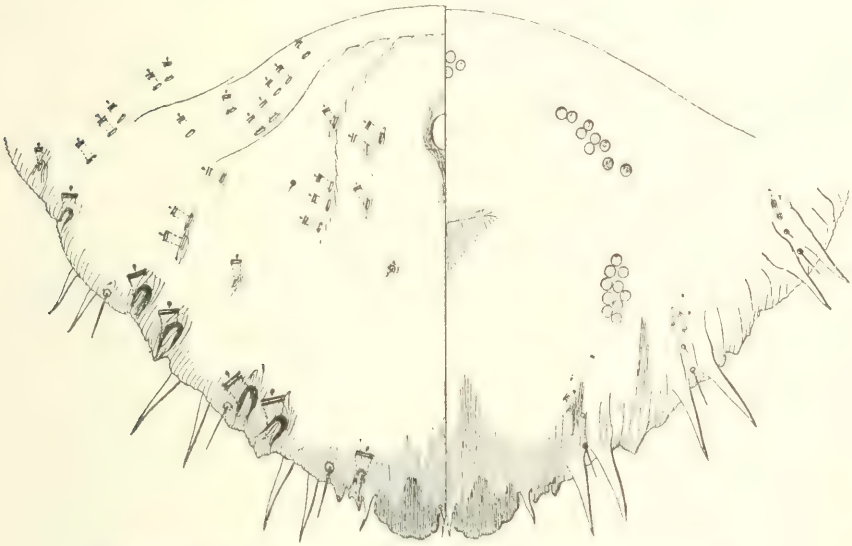

Fig. 36.—*Lepidosaphes mimosarum* (Ckll.): pygidium of adult.

*Habit.* Occurring for the most part beneath the surface of the ground but occasionally on the twigs or even on the leaves. Scale of female of the type common to the genus, about 2 mm. long, gray or brown, rather slender, frequently curved; exuviae naked. Scale of male in form resembling that of the female but lighter in color.

*Morphological characteristics.* Adult female about 1 mm. long, derm membranous throughout except for the pygidium. Cephalothorax not greatly elongate, not divided by intersegmental constriction and not sharply separated from the abdomen. Lateral margins of the abdominal segments projecting but little, each with two or three small gland spines and several small ducts. Dorsum of abdomen without ducts.

Pygidium (Fig. 36) with the median lobes alone well developed, these large, low and broad, with the tips rounded and slightly crenulate. Second pair of lobes represented merely by a small, toothlike projection. Between the first and second lobes is a small gland spine and a pore prominence bearing a rather large pore with chitinous rim. Beyond the second lobe are two large gland spines followed by two gland prominences bearing large pores with chitinous rims, then a spine, two more large gland spines, two large submarginal pores, a spine, two gland spines, and another submarginal pore. All the submarginal pores with conspicuous chitinous rims. Dorsal ducts considerably smaller than those of the margin, rather few, arranged as indicated in the figure. Microducts very small. Anal opening large, quite close to the anterior margin of the pygidium. Ventral side with three rows of very small ducts. Circumgenital pores in three groups, the cephalic group with 5-6 pores, the others with 10–20.

Notes: This determination has been confirmed by Mr. Morrison who has compared specimens with the mounts from the type material in the National Collection.

### **Lepidosaphes obtecta** n. sp.

Figs. 37, 38.

*Type* from *Atriplex* sp., at La Paz. Also from a species of *Acacia* or *Mimosa* and from *Fouquieria peninsularis* ("palo de Adan") at La Paz.

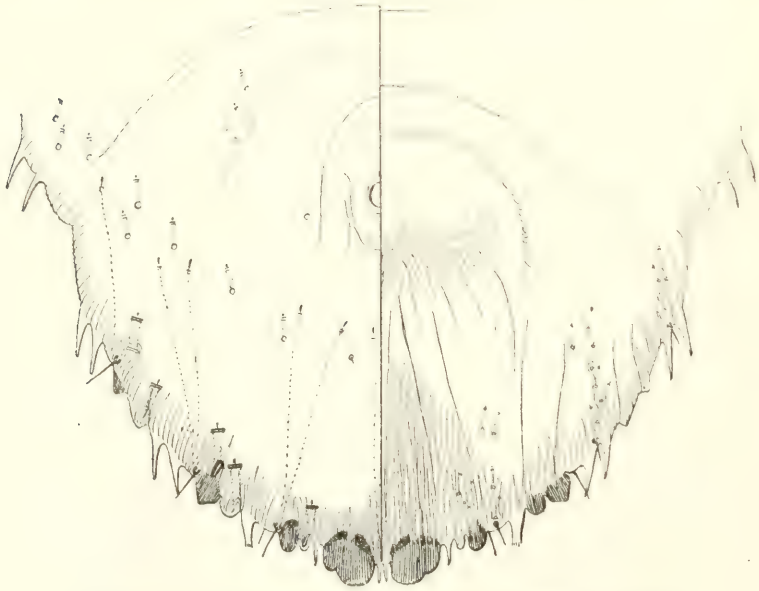

Fig. 37.—*Lepidosaphes obtecta* n. sp.: pygidium of adult.

*Habit.* Occurring in cracks in the bark. But a few specimens were found and in each case the scale was destroyed in searching for it. The second exuvium is very large but does not inclose the adult.

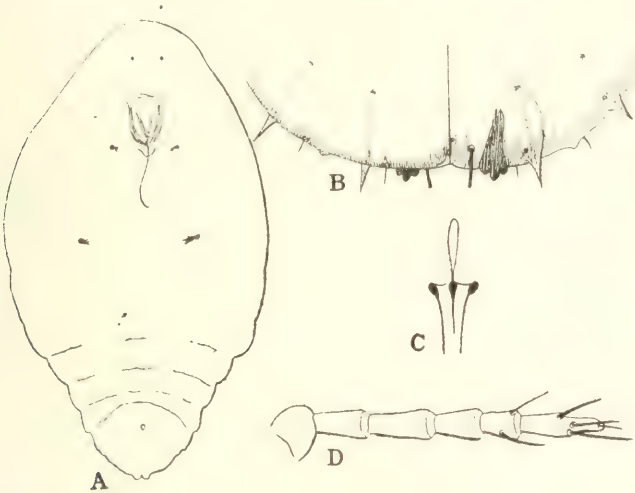


Fig. 38.—*Lepidosaphes obtecta* n. sp.: A, adult female; B, pygidial margin of first stage; C, extremity of microduct; D, antenna of first stage.

*Morphological characteristics.* Adult female (Fig. 38A) about .75 mm. long, elongate oval, tapering posteriorly, derm membranous throughout except for the pygidium, the greater part of the body occupied by the cephalothorax. Margins of the abdominal segments projecting but little, without gland spines but with numerous small ducts. Dorsum of the abdomen without ducts.

Pygidium (Fig. 37) rounded, bearing two, or perhaps three, pairs of lobes. Median pair quite large with a deep notch on the outer margin, separated by a small space in which are two small gland spines. Second pair very small, low and rounded. Between the first and second pairs is a small gland spine and a pore prominence. Beyond the second lobe is a rather large gland spine, a pore prominence, and a sharply pointed, chitinous prominence, a small chitinous tooth, a spine and two gland spines. Ducts few, those of the dorsum smaller than those of the margin, their arrangement as indicated in the figure. Microducts very long and slender, terminating in a structure of the type indicated in Fig. 37C. Anal opening moderately large, somewhat cephalad of the center of the pygidium. Ventral side with three rows of small ducts. Circumgenital pores lacking.

Second stage resembling the adult but without dorsal pores.

First stage with the antennae (Fig. 38D) 5-segmented, the terminal segment neither elongate nor annulate, the pygidium (Fig. 38B) with a single pair of rather large lobes.

Notes: This is a very peculiar species of doubtful affinities that I place in *Lepsidosaphes* only because of the lack of a better place.

### **Lepidosaphes peninsularis** n. sp.

Figs. 39, 40.

*Type* from *Porophyllum gracilis* ("yerba del venado") between La Paz and San Pedro. Also from the same host at Agua Caliente; *Asclepias subulata* at La Paz and San Jose del Cabo; undertermined Euphorbiaceous shrub at La Paz.

Fig. 39.—*Lepidosaphes peninsularis* n. sp.: pygidium of adult.

*Habit.* Occurring on the stems and leaves of the host. Scale of female of the form common to the genus, about 3 mm. long, straight, white, or slightly brown; exuviae covered with secretion. Scale of male similar to that of female but smaller.

*Morphological characteristics.* Adult female (Fig. 40A) about 2 mm. long, derm membranous except for the pygidium; margins of the abdominal segments projecting but little, without gland spines but with numerous small ducts. Dorsum of the abdomen practically without ducts.

Pygidium (Fig. 39) rounded, with two pairs of lobes. Median pair widely separated, short, rounded. Second pair small, distinctly

bilobed. Between the first and second lobes is a very small gland spine and pore. Beyond the second lobes is a very small gland spine followed by two submarginal pores, a spine, a gland spine, two submarginal pores,

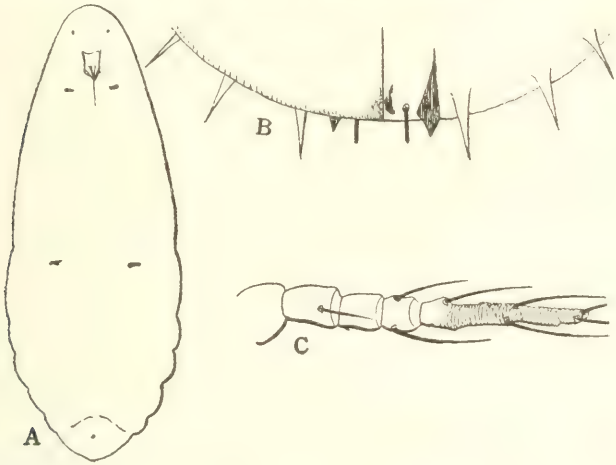


Fig 40.—*Lepidosaphes peninsularis* n. sp.: A, adult female; B, pygidial margin of first stage; C, antenna of first stage.

a spine, two submarginal pores, a spine and a single pore. Submarginal pores with chitinous rims. Dorsal ducts smaller than those of the margin, scattered, their arrangement as indicated in the figure. Microducts very small. Anal opening large, near the center of the pygidium. Ventral side with a few very small ducts. Circumgenital pores in five groups of 5 to 12 pores.

Second stage very similar to adult but lacking dorsal ducts.

First stage with the antennae (Fig. 40C) 5-segmented, the terminal about as long as the others combined and distinctly annulate; pygidium (Fig. 40B) with one pair of quite large lobes.

Notes: This species is very close to *L. concolor* (Ckll.), but it differs from the latter in the low, rounded and rather widely separated median lobes. In the numerous specimens of both species that I have examined I have found no intergradation.

## Genus **ODONASPIS** Leon.

### **Odonaspis litorosa** n. sp.

Figs. 41, 42.

*Type* from *Rachidospermum mexicanum* on the beach at the Eureka ranch near La Rivera. The host is a coarse, stiff beach grass that is known only from this region.

*Habit.* Occurring beneath the sheathing base of the leaves. Scale of female 2.5 mm. long, elongate oval, white. First exuvium naked, second white. Ventral scale continuous with the dorsal scale, thick, composed in part of the ventral portion of the second exuvium. Scale of the male of the type common to the genus.

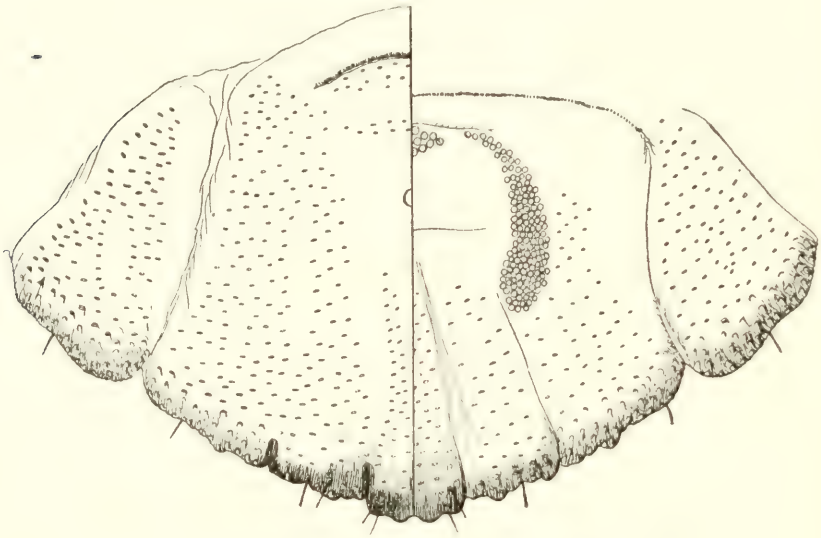

Fig. 41.—*Odonaspis litorosa* n. sp.: pygidium of adult.

*Morphological characteristics.* Adult female (Fig. 42B) about 1.25 mm. long, elongate oval, derm membranous except for the pygidium and the margins of the abdominal segments. Lateral margins of the abdominal segments with great numbers of small ducts.

Pygidium (Fig. 41) without definite lobes but with two pairs of small and quite widely separated paraphyses. Dorsum with a great number of small ducts. Anal opening quite small, somewhat cephalad of the center of the pygidium. Ventral side with numerous small ducts, these confined to a broad marginal zone. Circumgenital pores numerous, arranged in three more or less confluent groups.

Second stage with the ducts almost lacking, the pygidium (Fig. 42A) with two pairs of paraphyses as in the adult and with a series of acute points along the margin.

First stage with the antennae (Fig. 42C) 5-segmented, the third segment quite long, the terminal segment somewhat elongate and slightly annulate; pygidium (Fig. 42D) with a single pair of small lobes.

Notes: Of the species known to me this most closely resembles *O. ruthae* Kotinsky, an Hawaiian species, from which it differs chiefly in the presence of the second pair of paraphyses.

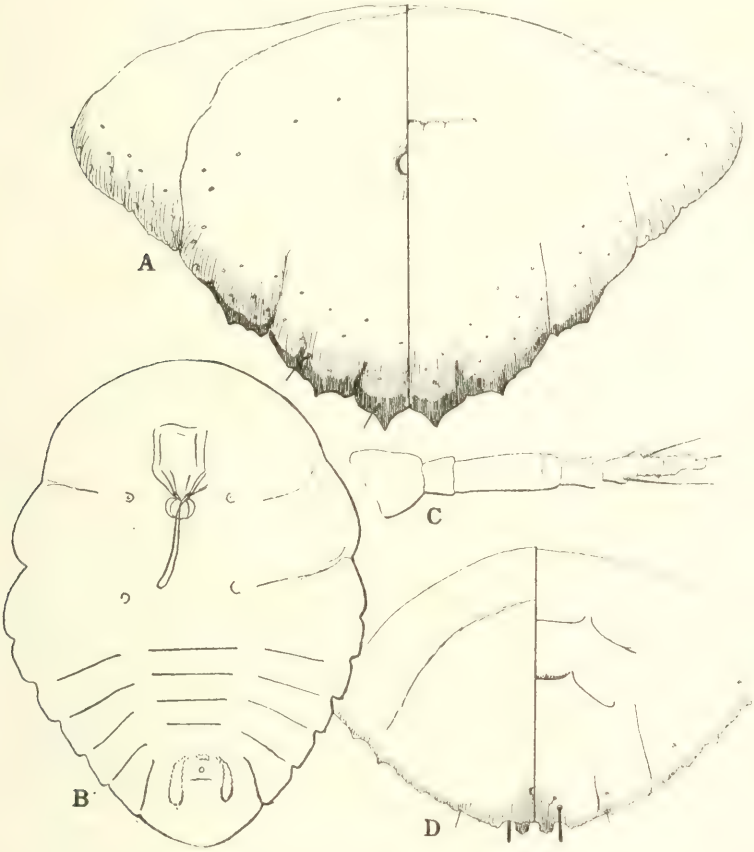


Fig. 42.—*Odonaspis litorosa* n. sp.: A, pygidium of second stage; B, adult female; C, antenna of first stage; D, pygidium of first stage.

**Odonaspis fistulata** n. sp.

Fig. 43.

*Type* from *Distichlis spicata* at Punta Palmilla near San Jose del Cabo.

*Habit.* Occurring beneath the sheathing bases of the leaves or on the upper surface of the leaves near the base. Scale of female about 2.5 mm. long, white, somewhat elongate with the exuviae near one end and naked; ventral scale thick, continuous with the dorsal scale, and composed in part of the ventral portion of the second exuvium as is common in this genus. Scale of male white, somewhat elongate, with the exuvium near one end.

*Morphological characteristics.* Adult female about 1 mm. long, somewhat elongate oval, in general resembling *O. litorosa;* derm membranous except for the pygidium and the lateral margins of the abdominal segments. Lateral margins of the segments with many small ducts.

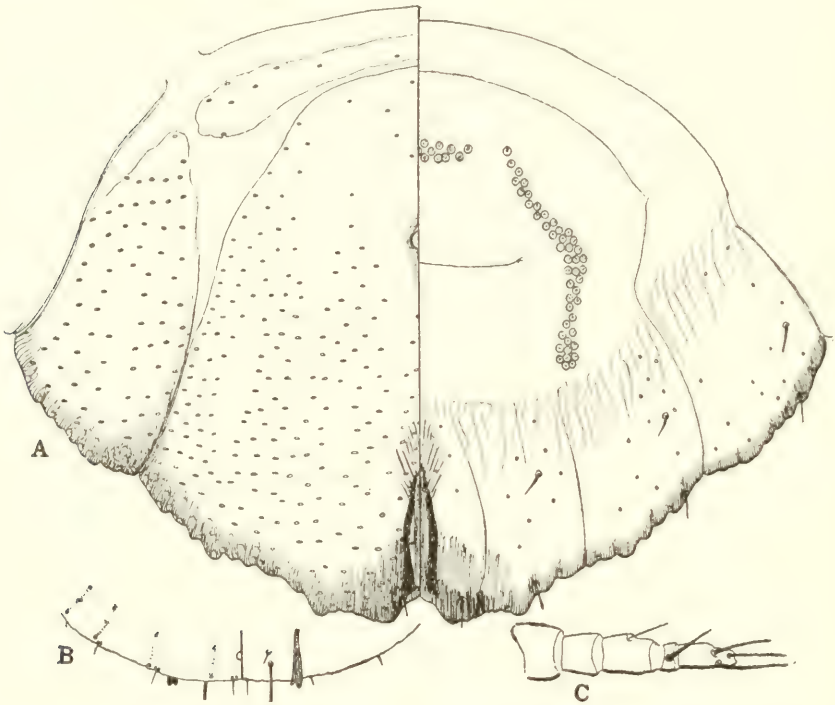


Fig. 43.—*Odonaspis fistulata* n. sp.: A, pygidium of adult; B, pygidial margin of first stage; C, antenna of first stage.

Pygidium (Fig. 43A) without lobes or paraphyses but with a median notch which is continuous with a tubular invagination which extends into the pygidium, and from the inner extremity of which there arises a cluster of slender ducts. Tubular ducts small, extremely numerous. Anal opening quite small, placed well toward the anterior margin of the pygidium. Ventral side with a few ducts, these confined to a broad marginal zone. Circumgenital pores present, numerous, arranged in three more or less confluent groups.

Second stage with the pygidium practically as in *O. litorosa* but with the tube present and with but the first pair of paraphyses developed.

First stage with the antennae (Fig. 43C) quite short and stout, 5-segmented, the third segment not elongate, and the terminal segment

neither elongate nor annulate; pygidium (Fig. 43B) with a single pair of widely separated lobes.

Notes: While this species is in most respects quite typical of the genus *Odonaspis* the presence of the invaginated apical tube is a peculiarity which it shares with but one other species, *O. canaliculata* Green. The latter species has been recorded only from India but in spite of the great geographical separation the two are certainly very closely related, differing chiefly in the fact that in the Indian species the circumgenital pores are lacking and the apical invagination extends nearly to the anal opening.

## Genus **ASPIDIOTUS** Bouché.

### **Aspidiotus candidulus** Ckll.

1919. *Aspidiotus candidulus* Ckll., Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, p. 63, fig. 35.

*Previous records.* From *Prosopis velutina,* Tucson, Ariz.

*Lower California records.* From yucca at Todos Santos.

### **Aspidiotus chortinus** n. sp.

Figs. 44, 45.

*Type* from *Chaetochloa caudata* at San Jose del Cabo.

*Habit.* Occurring beneath the sheathing bases of the leaves. Scale of female 1.5-2 mm. in diameter, white, quite thick and firm, circular or

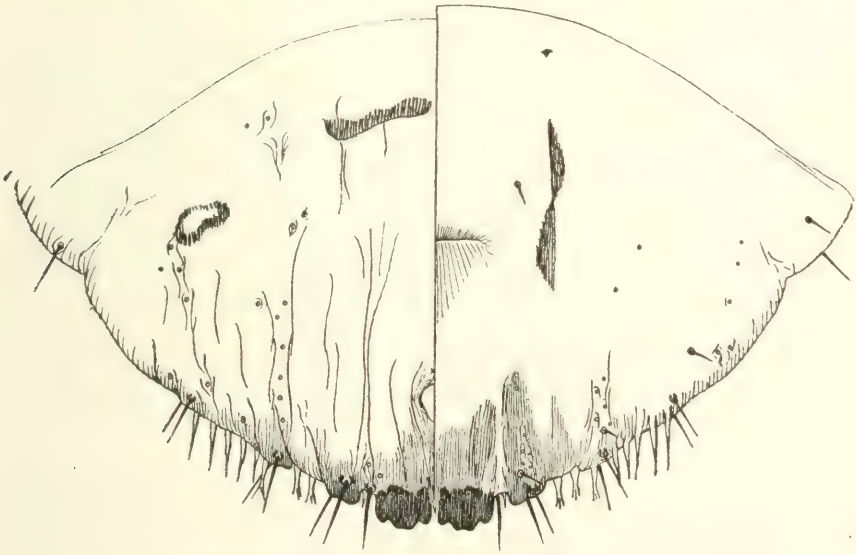

Fig. 44.—*Aspidiotus chortinus* n. sp.: pygidium of adult.

subcircular, with the exuviae subcentral, covered with secretion; ventral scale thick, composed in part of the ventral portion of the second exuvium. Scale of male quite elongate oval, with the exuvium at one end, in color and texture resembling that of the female.

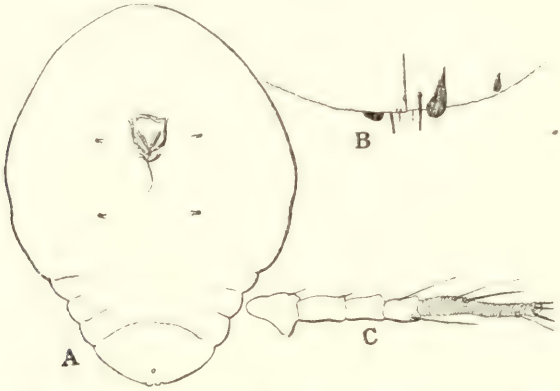


Fig. 45.—*Aspidiotus chortinus* n. sp.: A, adult female; B, pygidial margin of first stage; C, antenna of first stage.

*Morphological characteristics.* Adult female (Fig. 45A) 1.5 mm. long, of ordinary form; derm membranous or with the anterior portion of the cephalothorax somewhat chitinized.

Pygidium (Fig. 44) rather short and broad, with the median lobes alone well developed, these large and broad, the lateral margins parallel, the apex truncate and with two deep notches. Second lobes broad and very low. Spines at the bases of the lobes quite long and conspicuous. Plates small but numerous; one or two that are very small, between the first and second lobes, and as many as ten beyond the second lobes, these variable in form, some being simple, others slightly branched. Dorsal ducts very few, small and slender, arranged as indicated in the figure. Anal opening quite large, scarcely more than twice its own diameter from the posterior margin. Ventral side with a very few small ducts, without paragenital pores. Vaginal opening flanked by a pair of elongated chitinized areas.

First stage with the antennae (Fig. 45C) 5-segmented, the terminal segment quite elongate and annulate; pygidium (Fig. 45B) with two pairs of widely separated lobes, the outer pair very small.

Notes: This species is very close to *A. graminellus* Ckll., a species that has been recorded from Colorado and New Mexico. It differs chiefly in the much greater development of the plates, both in number and size, and in the much fewer and smaller dorsal ducts. It is possible that it will prove to be a subspecies of *graminellus*.

**Aspidiotus diffinis** Newst.

Figs. 46, 47A, 47B.

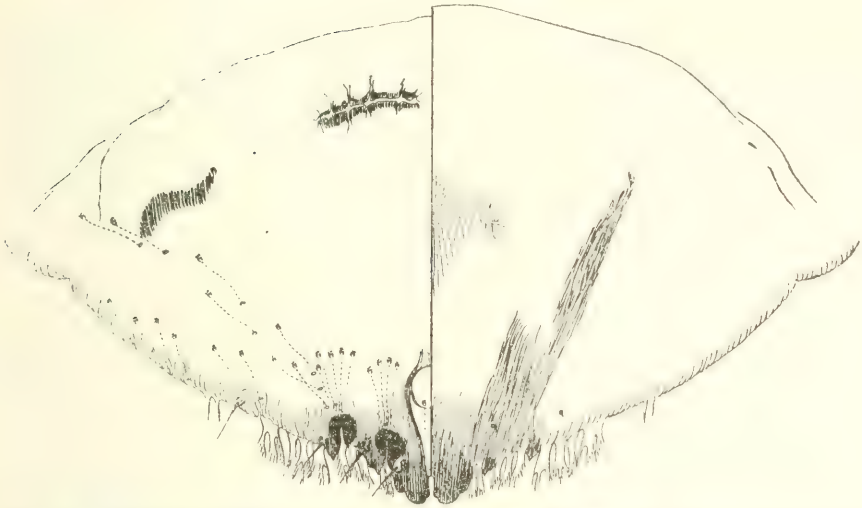

Fig. 46.—*Aspidiotus diffinis* Newst.: pygidium of specimen from guava at La Paz.

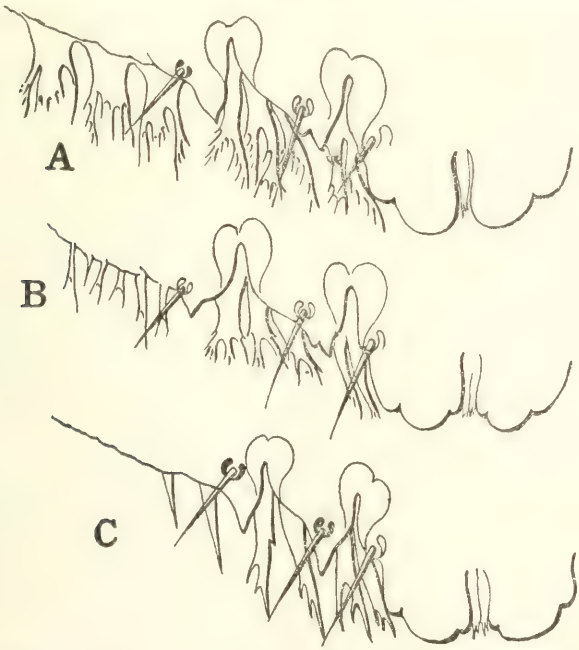


Fig. 47.—*Aspidiotus diffinis* Newst.: A, pygidial margin of specimen from guava at La Paz; B, pygidial margin of specimen from *Liriodendron* in New Jersey; *Aspidiotus rapax* Comst.: C, pygidial margin of specimen from *Ceanothus* in California.

*Previous records.* From Canada, eastern United States, Mexico, and the West Indies, on various hosts.

*Lower California records.* From guava at La Paz.

Notes: In all respects this species is so very similar to *A. rapax* Comst., that the two may very easily be confused, the general characters of the pygidium being practically identical. My specimens present a considerable amount of variation in the number and size of the plates (Figs. *47A, B*) but they appear constantly to differ from *rapax* (Fig. *47C*) in the more or less deeply notched second lobe and the much finer branching of the plates.

As an additional host and locality, I may add *Liriodendron tulipiferae* in New Jersey, (col. Doane) and "shade tree" at Raleigh, North Carolina, (from collection of R. S. Woglum).

### **Aspidiotus densiflorae** Bremner.

1920. *Asipidiotus densiflorae* Bremner, Ferris: "Scale Insects of the Santa Cruz Peninsula," Stanford University Publications, *Biological Sciences,* **1**:1:50, fig. 27.

*Previous records.* From *Pasania densiflorae* ("tan oak") and *Quercus chrysolepis* in California.

*Lower California records.* From an herbarium specimen of *Quercus tomentella* from Guadeloupe Island, an island about two hundred miles off the Pacific coast of the peninsula.

### **Aspidiotus lataniae** Sign.

1899. *Aspidiotus lataniae* Sign., Green: *Ent. Mon. Mag.,* **35**:181.

*Previous records.* A widely distributed tropical, subtropical, and greenhouse species.

*Lower California records.* From *Forchammeria watsoni* ("palo de San Juan") at La Paz; *Karwinskia humboldtiana* between Cabo San Lucas and Pescadero; mango at San Bartolo.

Notes: As there has been much confusion concerning the proper application of the name *lataniae* I may point out that I am using the name for the species described by Green in the reference cited above. This appears to be the species that has ordinarily passed under the name of *A. cydoniae* Comst.

### **Aspidiotus osborni** Ckll. and Newell.

1920. *Aspidiotus osborni* Ckll., Ferris: "Scale Insects of the Santa Cruz Peninsula," Stanford University Publications, *Biological Sciences,* **1**:1:51, fig. 29.

*Previous records.* Widely distributed on various species of oak in the United States.

*Lower California records.* From *Quercus brandegeei* near Santiago.

Notes: I have but a single specimen from Lower California, this agreeing quite closely with typical *osborni* except in having the plates somewhat larger.

**Aspidiotus pedilanthi** n. sp.

Fig. 48.

*Type* from *Pedilanthus macrocarpa* ("candelilla") near Pescadero. Also from *Horsfordia* sp. at San Pedro; *Franseria* sp. at Todos Santos; *Populus* sp. at San Jose del Cabo.

*Habit.* Occurring for the most part on the crowns of the host. Scale of female circular, about 1.5 mm. in diameter, flat, gray, exuviae submarginal, covered. Scale of male slightly elongate.

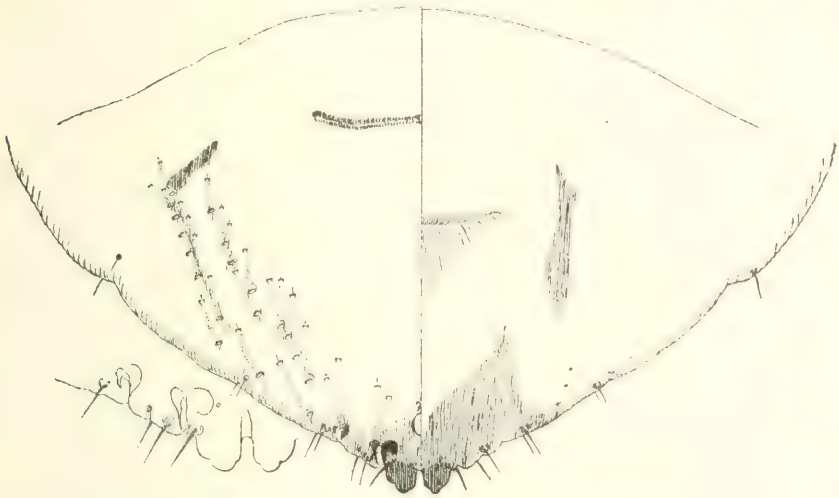

Fig. 48.—*Aspidiotus pedilanthi* n. sp.: pygidium and pygidial margin of specimen from type host.

*Morphological characteristics.* Adult female 1.6 mm. long, of the normal turbinate form, menbranous or with the cephalothorax tending to be somewhat chitinous. Margins of the adbominal segments without ducts.

Pygidium (Fig. 48) entirely without plates and with the lateral lobes entirely obsolete. Median lobes prominent, straight, and with a distinct subapical notch on the outer margin. First poriferous furrow with the paraphyses well developed, the inner paraphysis distinctly clavate, the outer straight and slender. Second furrow with the paraphyses quite small. Tubular ducts quite small and slender, quite numerous, arranged as indicated in the figure. Anal opening small, slightly cephalad of the apex of the first paraphyses. Ventral side with a few very minute marginal and submarginal ducts. Paragenital pores lacking. Vaginal opening flanked by a pair of elongated chitinized areas.

Notes: This species is certainly very close to *A. coursetiae* Marlatt, from northwestern Mexico, and *A. covilleae* Ferris (which is perhaps a synonym of *coursetiae*) from Arizona. It differs from both in the complete absence of paragenital pores. It is not impossible that the examination of a large enough series would show an intergradation in this respect as *coursetiae* is described as having the number of pores in each group very small.

### **Aspidiotus rapax** Comst.

*Previous records.* A cosmopolitan species on innumerable hosts.

*Lower California records.* From *Rhus laurina* at Ensenada; *Pithecolobium dulce* ("guamuchil") at Miraflores; *Heteromeles arbutifolia* and *Arbutus peninsularis* at La Laguna.

### **Aspidiotus spinosus** Comst.

Fig. 49.

*Previous records.* A greenhouse species, previously recorded from Washington, D. C., and from England.

*Lower California records.* From cultivated grape and asparagus fern at La Paz.

Fig. 49.—*Aspidiotus spinosus* Comst.: pygidium of specimen from grape at La Paz.

Notes: This determination has been confirmed by Mr. Morrison, who has compared specimens with the type. I present a figure of the pygidium.

## Genus **CHRYSOMPHALUS** Ashmead.

### **Chrysomphalus aonidum** (Lin.).

*Previous records.* A widely distributed tropical and greenhouse species.

*Lower California records.* From an undetermined ornamental at La Paz.

### **Chrysomphalus enceliae** n. sp.

Fig. 50.

*Type* from a large composite, *Encelia palmeri,* in the canyon at Todos Santos.

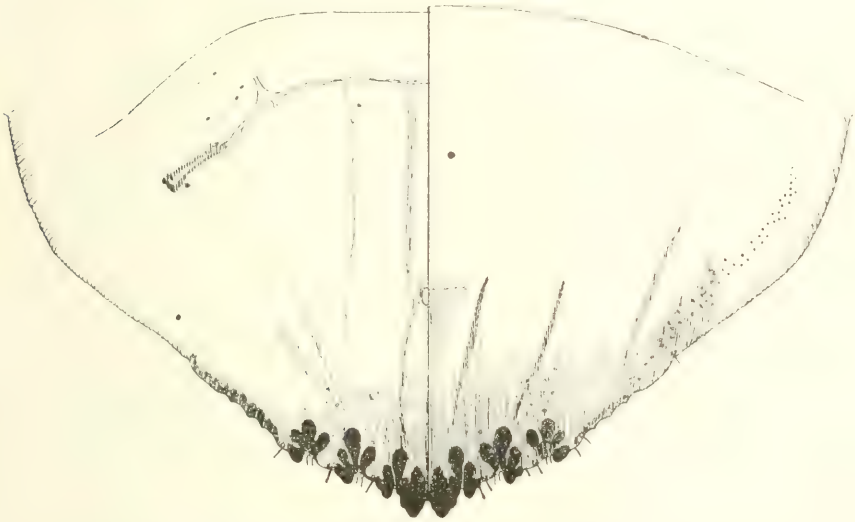

Fig. 50.—*Chrysomphalus enceliae* n. sp.: pygidium of adult.

*Habit.* Occurring on the trunk of the host, sometimes concealed beneath loose bark. When not thus concealed the dorsal scale becomes very easily detached, leaving the conspicuous white ventral scale. Scale of female roughly circular, flat, black, hard and brittle, 2-3 mm. in diameter. Scale of male not identified.

*Morphological characteristics.* Adult female about 2 mm. long, of the normal turbinate form, the anterior portion of the cephalothorax tending to be quite heavily chitinized.

Pygidium (Fig. 50) heavily chitinized, short and broad. Four pairs of lobes present, the median pair quite large, the others mere projections, all rounded at the apex. Paraphyses well developed, rather short

and stout, arranged as follows: One at each basal angle of the median lobe, the outer the longer; one at the base of the second lobe, this quite short; three at the inner basal angle of the third and fourth lobes, the middle one of each group the longest. Tubular ducts few, slender, and inconspicuous, confined, except for one or two, to the margin beyond the third pair of lobes. Anal opening quite small, slightly caudad of the center of the pygidium. Ventral side with numbers of very minute ducts. Paragenital pores lacking.

First stage identical with that of *C. induratus* n. sp. (Fig. 52D) which is described below, except that the terminal segment of the antennae is slightly shorter.

Notes: Of the species known to me this most closely resembles *C. nigropunctatus* (Ckll.), from Mexico, from which it differs essentially only in the absence of the paragenital pores.

## **Chrysomphalus induratus** n. sp.

Figs. 51, 52.

*Type* from *Pinus cembroides* at La Laguna. Also from *Quercus brandegeei* between Cabo San Lucas and Pescadero; undetermined mimosaceous shrub at San Bartolo and *Vachellia farnesiana* at Todos Santos.

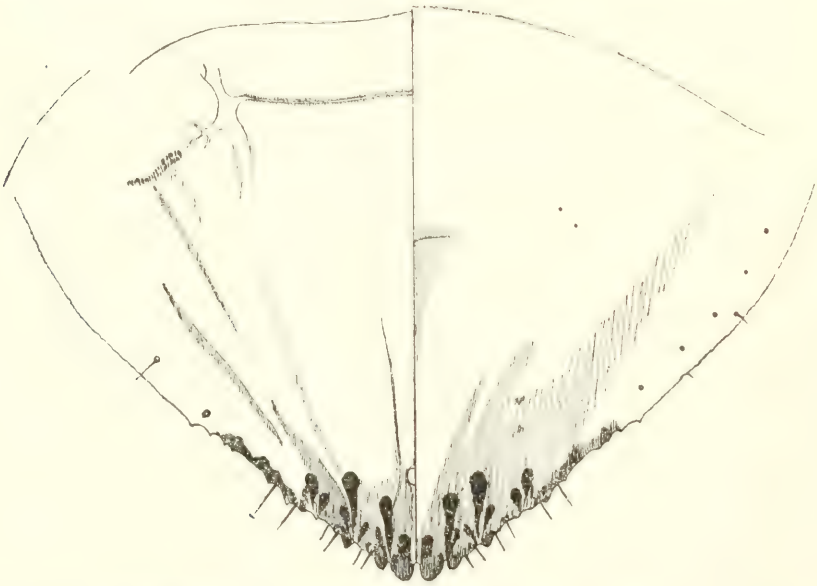

Fig. 51.—*Chrysomphalus induratus* n. sp.: pygidium of specimen from *Pinus cembroides*.

*Habit.* Occurring on the bark of the host, those on pine being chiefly on the smaller twigs, the dorsal scale becoming detached very easily. Scale of female circular, about 2 mm. in diameter, black, flat, hard and brittle. Ventral scale very thin. Scale of male not identified.

*Morphological characteristics.* Adult female (Fig. 52E) of the usual turbinate form, the derm membranous except for the anterior portion of the cephalothorax, which tends to be more or less heavily chitinized anteriorly.

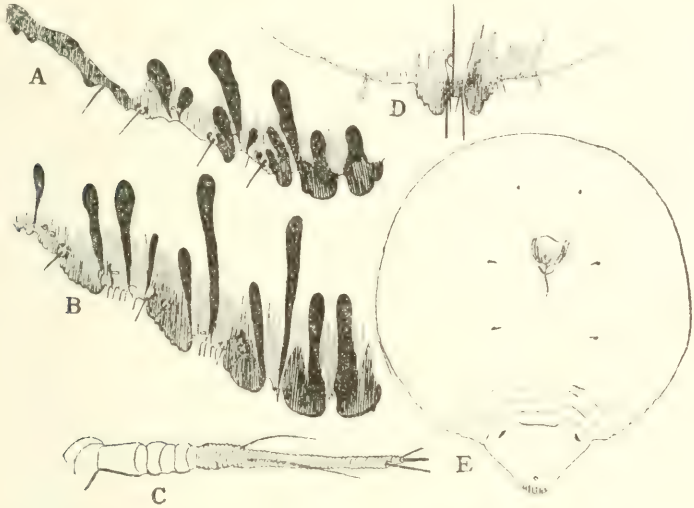


Fig. 52.—*Chrysomphalus induratus* n. sp.: A, pygidial margin; C, antenna of first stage; D, pygidial margin of first stage; E, adult female. *Chrysomphalus lilacinus* Ckll.: B, pygidial margin of adult.

Pygidium (Figs. 51, 52A) rather acute, the median lobes prominent and rounded, the second and third consisting of but little more than slight projections. Paraphyses well developed, arranged as follows: a rather long paraphysis at inner basal angle of each median lobe and one about twice as long at the outer angle; one at each angle of second lobe, the inner of these the longer but not exceeding half the length of the outer paraphysis of the median lobe; one very small, between the second and third lobes, followed by one about as long as the longest of the median paraphyses and one less than half as long at base of third lobe; two beyond the third lobe. Plates entirely lacking. Ducts long and slender, few, their pores confined to a marginal area beyond the third lobes. Anal opening small, slightly cephalad of the median paraphyses. Ventral side with a few very small ducts. Paragenital pores lacking.

First stage with the antennae (Fig. 52C) 5-segmented, the terminal segment much elongate and annulate; pygidium (Fig. 52D) with a single pair of prominent median lobes.

Notes: This species is quite close to *C. lilacinus* Ckll., a species that has been recorded from oaks in southwestern United States and northern Mexico. However, the lobes in *lilacinus* (Fig. *52B*) are much larger, the paraphyses are much longer and somewhat differently arranged.

## Genus **TARGIONIA** Sign.

### **Targionia yuccarum** (Ckll.).

1919. *Targionia covilleae* Ferris, Ferris: "Contribution to the Knowledge of the Coccidae of Southwestern United States," Stanford University Publications, pp. 66, 68, fig. 38.

1920. *Targionia yuccarum* (Ckll.), Ferris: *Can. Ent.*, **52**:64.

*Previous records.* From Yucca and *Chrysothamnus* in New Mexico, *Covillea glutinosa* in Arizona and undetermined host in Mexico.

*Lower California records.* From *Atriplex* sp. at La Paz.

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# New Species of Melyridae, Chrysomelidae and Tenebrionidae (COLEOPTERA)

## From the Pacific Coast, with Notes On Other Species

BY
FRANK E. BLAISDELL, SR.
Associate Professor of Surgery
Permanent Secretary of the Pacific Coast Entomological Society

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# CONTENTS

# INTRODUCTION

The material on which the present avocational studies are based, was collected chiefly in California, the smaller part having been taken in Washington, Oregon, Nevada, Lower California and Islands off the coast. The following Coleoptera are described as new to science: Twenty species and one subspecies of *Listrus*; two species and one variety of *Dasytes;* one species of *Dasytastes;* one species and the genus *Listrimorpha*; two species of *Glyptoscelis*; two species of *Centrioptera*; three species of *Schizillus*; one species of *Coniontis*; one species of *Coniontides*; one species of *Eusattus*; five species and three races of *Eleodes* and three species of *Helops*. Notes on a few other species are also given. At all times an effort has been made to examine long series, and uniques have been considered only when they presented well marked characters, and even then collateral evidence was at times obtained from colleagues or collectors in the field.

I am greatly indebted to the California Academy of Sciences for the privilege of studying the material in the collection of its entomological department; also, to Mr. Van Duzee, curator of the department, for personal favors. The following friends and collectors have responded generously to my requests for material and, to them I express my sincere thanks: Mr. J. O. Martin for the liberal gift of specimens from the Bear Lake region in San Bernardino County, and Mr. F. W. Nunenmacher for similar gifts and the opportunity of studying long series of specimens from different regions in California. Mr. Chas. Liebeck of Philadelphia very kindly loaned the material in his collection. To Mr. H. C. Fall, Mr. Chas. L. Fox and Mr. O. N. Sanford my appreciation is due for less extensive but none the less valuable assistance.

# PART I.

## Family **Melyridae.**

As recently decreed by the leading Coleopterists of the United States, the old family name Malachidae gives way to Melyridae [1]; the latter includes three subfamilies, namely: Malachiinae, Melyrinae and Rhadalinae.

Nothing of any extent has been written on the American Melyrinae since Col. Casey's excellent paper published in 1895 [2]. Fall added a few species in 1901 [3] and 1907 [4]. In 1906 [5] I described two new species of *Dasytes*.

### **Listrus** Mots.

The genus *Listrus* is proving to be more extensive and a less homogeneous aggregate than was at first suspected. Its specific units are characterized by an elongate and more or less subparallel convex body, more or less sparse and variegated vestiture without intermixed setae, tarsi more or less variable as to length and stoutness, with the basal joint of the posterior slightly longer than the second, the fifth somewhat dilated toward the tip and canaliculate above at apex as usual throughout the family, the anterior tibiae slender, cylindrical, usually with closely decumbent ashy pubescence and only occasionally with two or three very slender, distant, external spines, these being completely obsolete as a rule.

Antennae somewhat variable as to length, more or less feebly incrassate, only slightly though distinctly serrate, with the first joint always much dilated and stout apically and usually darker in color, the fifth larger than the fourth or sixth, usually triangular, sometimes the sixth and eighth joints are smaller than the seventh, and the eleventh more or less evenly elongate-ovoidal or obovate and obtusely acuminate or truncate at tip. The pronotum is dilated behind the middle, with the lateral edge more or less minutely serrulate and having an even fringe of short superiorly recurved setae, which are almost invariably cinereous in color, the apical angles usually more or less rounded. Epipleura very narrow but dilated toward base, with their plane strongly inclined upward throughout. The ungual appendages are thick, equal and fully as long

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[1] "Leng's Catalogue of the Coleoptera of America North of Mexico," 145, 1921.

[2] "Coleopterological Notices," **6**, *Annals New York Academy of Sciences*, **8**, 456, July, 1895.

[3] "Occasional Papers," *California Academy of Sciences*, **8**, 248–251, 1901.

[4] "The Coleoptera of New Mexico," *Transactions of the American Entomological Society*, **33**, 236–240, 1907 (Malachidae).

[5] *Entomological News*, **17**, 74–76, March, 1906.

as the claws, the apical third or fourth of which is free. The above characterization has been modified from Casey.

Fall has called attention to the fact that the males of all species have the protibiae mucronate at the tip. The spurs of the meso- and metatibiae are variable, especially on the latter; generally moderately short and blunt on the former. A study of the spurs and mucros will constitute a special line of investigation. A monographic treatment of the genus should not be attempted until a greater amount of collecting has been done and a larger series of a greater number of species been secured.

From my own studies it is evident that for the proper description and diagnosis of the species, attention must be paid to the structure of the antennae, pronotum, pattern of maculation, fifth ventral abdominal segment, and the legs, especially the femora and the metatrochanters.

I have assumed that the fundamental type of maculation in its discrete form, consisted of four transverse fasciae of more or less cinereous pubescence that divided the dark elytral field into five dark fasciae which may be known as the basal, post-basal, median or submedian, subapical and apical; it is by the extension of the light fasciae that the dark areas are broken up, or by the diffusion and coalescence of the dark fasciae or maculae that the varied pattern of maculation is produced. This conception of a definite fundamental pattern of maculation will help greatly in the interpretation of the species from color markings.

It is necessary to caution students who endeavor to identify the different species, that it is absolutely essential for the proper recognition and appreciation of antennal characters to view the several joints at right angles to their broad surfaces, which according to my terminology are the dorsal and ventral surfaces; viewing the antennae edgewise—antero-posteriorly—determines the degree of compression. The careless viewing of the surface at a tangent will result in an erroneous conception of the relative proportions of the parts.

It is not sufficient to simply examine the specimens with a low-power hand lens, but with as powerful a glass as can be obtained. The failure to recognize the many undescribed species in the past has been due to the inability to see the abundance of good specific characters. In the present study the binocular and stereoscopic microscopes were used.

## Descriptions of New Species.

*Listrus cephalicus*, new species.—*Form* oblong-oval, very moderately convex. *Color* black, upper surface with a bluish or subaeneous metallic lustre; antennae and legs nigro-piceous.

*Pubescence* moderately short and sparse, recumbent, cinereous hairs not abundant; brownish-black hairs arranged in an indefinite pattern in which the maculae and fasciae observed in other species diffuse and

coalesce, so that the prevailing color is dark. Pronotal maculae not discernible on account of the abundance of dark hairs.

*Head* comparatively large and moderately transverse; eyes large and more strongly convex in anterior two-thirds and, there unusually prominent, anterior surface quite abrupt, posteriorly forming a straight line with the tempora which are quite strongly convergent behind; frons broad, rather strongly and very broadly impressed, surface densely indentato-punctate, punctures coarser and less crowded on the vertex. *Antennae* long and stout, slightly compressed, gradually but not strongly incrassate; second joint stout, as wide as the sixth, nearly oval but slightly narrowed at base; third subequal in length to the second, rather strongly obconical and almost twice as long as wide; fourth subtriangular, about as long as wide, subserrate anteriorly, apical margin oblique and about as wide as the seventh; fifth subequilaterally triangular, distinctly serrate anteriorly, apical margin oblique and about as wide as the ninth; sixth, seventh and eighth subequal in size, sixth triangular, about as long as wide, subserrate anteriorly; seventh very slightly longer, triangular; eighth slightly transverse and triangular; ninth stouter, wider than long, anterior margin not strongly arcuate; tenth wider than long, subtriangular with sides distinctly arcuate; eleventh obovate, not wider than the tenth, truncate at tip, almost a half longer than wide.

*Pronotum* almost a third wider than long, widest just behind the middle; apex arcuato-truncate in circular arc; apical angles quite broadly rounded; sides rather strongly and evenly arcuate in posterior two-thirds, thence straight and rather strongly convergent to apex, serrules strong, subobtuse, about as long as wide at base, fimbria rather short and not closely placed; base quite broadly and moderately arcuate, rather broadly but not strongly sinuate within the basal angles, which are more or less obtuse; disk broadly and quite evenly convex posteriorly, more strongly so anteriorly and arcuately declivous antero-laterally, densely and rather strongly indentato-punctate, punctures rather coarse and strong.

*Elytra* oblong, rather less than twice as long as wide, humeri somewhat prominent, base rather transverse; disk quite coarsely punctate, surface more or less transversely rugose or wavy, smoother toward apex where the punctures are finer and not impressed; feeble parascutellar prominences rather discretely punctured and not rugose. Scutellum quadrate.

*Abdomen* finely punctulate and densely microreticulate; broad at base, sides converging rather strongly toward apex.

*Legs* rather stout and somewhat long; tarsi elongate and also stout.

*Male.*—Oblong-suboval. Metafemora broad and moderately flat-

tened; metatibiae distinctly thickened in apical two-thirds, very feebly arcuate; fifth ventral abdominal segment about as long as the second, broadly and transversely truncate at apex; a sixth segment is visible and the under surface of the pygidium rather flat and fringed with quite short and stout black hairs.

*Female* unknown.

*Measurements.*—Length, 3.4 mm.; width, 1.2 mm. Holotype, male, in the collection of the California Academy of Sciences. Described from a unique, collected by Mr. E. P. Van Duzee, on April 21st, 1918.

*Type locality.*—Salada Beach, San Mateo County, California.

*Cephalicus* is a very distinct and unique species in its prominent and peculiarly convex eyes, broad head, stout antennae and legs, besides the preponderance of dark hairs on the upper surface with consequent obscuration of the maculation.

*Listrus coloradensis*, new species.—*Form* oblong, subovate, moderately convex. *Color* black, surface rather dull and with a feeble bluish lustre; antennae piceous, legs rufo-piceous.

*Pubescence* very short, rather coarse and more or less squamiform, not dense, rather inconspicuous, plumbeo-cinereous in color above but more cinereous beneath where it is somewhat longer and closely recumbent; noticeably coarse on front of the head.

*Head* slightly transverse, eyes rather large and moderately prominent; front broadly impressed, more strongly and somewhat bi-impressed between the antennae, densely but not coarsely indentato-punctate, sometimes with a small subglabrous convexity close to the middle of the epistomal base. *Antennae* rather short and somewhat stout and nearly similar in the sexes; second joint slightly oblong-oval, just a little longer than wide; third distinctly obconical and nearly twice as long as wide; fourth a little stouter, subobconico-triangular and about as long as the sixth; fifth subequal to the ninth in width, subtriangular and serrate, very little longer than wide and obliquely truncate at apex; sixth and eighth subequal, quite distinctly smaller than the contiguous joints, very slightly wider than long and feebly triangular; seventh triangular and about as long as wide, more prominent anteriorly than posteriorly, slightly longer than the sixth or seventh; ninth and tenth stouter, a little wider than long subtriangular, sides feebly arcuate; eleventh obovate-triangular, scarcely a half longer than wide.

*Pronotum* about a fourth wider than long, quite equal in width to the elytral base; apex arcuato-truncate in circular arc; sides moderately rounded in basal half, thence almost straight to the apical angles as viewed from above, serrules small, fimbriae rather short and stout; apical angles obtusely rounded; base broadly arcuate, rounding evenly into the sides;

disk moderately convex basally, arcuately declivous antero-laterally, densely but not coarsely indentato-punctate.

*Elytra* oblong-oval, about twice as long as wide, humeri rather prominent; disk not strongly punctate, punctures shallow, separated by a distance equal to two or three times their diameters, surface microscopically reticulate; apex parabolically rounded, sutural angles rather more than narrowly rounded.

*Abdomen* finely and sparsely punctate, surface microscopically reticulate.

*Legs* rather short.

*Male.*—Slightly narrower. Fifth ventral segment arcuato-truncate at apex. Antennal joints five, six and seven similar in form, subtriangular, more prominent anteriorly than posteriorly, eighth smaller by one-eighth.

*Female.*—Slightly broader. Fifth ventral rather parabolically rounded. Antennae slightly more slender, joints six and eight smaller, similar in form; tenth and eleventh feebly transverse, sides arcuate and symmetrical.

*Measurements.*—Length (Types), 2.9–3 mm.; width, 1–1.2 mm. Holotype, male, and allotype, female, and two paratypes in my own collection.

*Type locality.*—Colorado, without definite locality.

In *senilis* the pubescence is coarse, dense and cinereous, and the tenth antennal joint is transverse; in *clavicornis* the pubescence is moderately long, not so coarse, and the tenth antennal joint is transverse as in *senilis,* while in *coloradensis* the pubescence is coarse on the head, pronotum and elytral base, the antennae are almost similar in the sexes, and the fifth ventral abdominal segment is arcuato-truncate in the male. Col. Casey has examined specimens of this species and pronounced it new.

*Listrus dilutus*, new species.—Sexes similar in form, oblong-oval, subparallel and somewhat robust, moderately convex. *Color* black, with a dark virido-metallic lustre; tarsi rufous to rufo-piceous.

*Pubescence* very short and inconspicuous, rather plumbeo-cinereous in color, recumbent and moderate in abundance. The maculation is difficult of determination, dark areas invested with dark-brownish hairs. Basal fascia is represented by a large parascutellar and a humeral macula on each elytron; a variable post-basal macula at middle of each which is frequently connected to the humeral forming a lunule; median fascia rather broad, edges feebly zig-zag, usually more or less interrupted at suture; subapical fascia rather wide, more or less entire and tending to dilate on the suture, edges rather irregular; apical maculae variable as to

size. Pronotal central macula evidently hourglass-shaped or oval, it may have a narrow median reëntrant pale line from apical and basal margins; lateral semilunar lines rather obscure; hairs darkish on front of head. Pronotal fimbriae moderately short and pale in color.

*Head* somewhat transverse, front nearly plane, feebly and longitudinally bi-impressed anteriorly, impressions separated by a feeble convexity, which is more or less glabrous at the epistomal base, punctures moderate, well defined, feebly impressed, separated by a distance equal to one or two times their diameter, intervals flat, feebly indentated toward the periphery; muzzle short. *Antennae* somewhat slender and rather long, very feebly incrassate and slightly compressed, less noticeably so in the outer joints, somewhat dissimilar in the sexes; first joint very stout; second oval, about a fourth longer than wide, narrowing slightly toward base; third subcylindrical, about twice as long as wide, as long as the fourth; fourth moderately compressed, almost subtriangular, feebly subangulate anteriorly; fifth elongate; sixth and seventh equal in length, less than a half longer than wide, scarcely subtriangular; eighth a little longer than wide, shorter than the ninth, slightly oblong-triangular; ninth and tenth distinctly longer than wide, somewhat oblong-triangular; eleventh elongate oval, slightly narrowed at apex, twice as long as wide; outer joints not noticeably wider.

*Pronotum* about a fourth wider than long, rather evenly convex, but more declivous antero-laterally; apex arcuato-truncate; apical angles broadly rounded into the sides; base broadly and rather strongly arcuate, somewhat lobed, more or less sinuate laterally; basal angles obtuse and more or less evident but not strong; sides broadly and moderately strongly arcuate, straighter and moderately convergent anteriorly, serrules short, blunt to subacute, intervals equal to their base; disk rather discretely punctured in middle third, punctures distinct, separated by a distance equal to one or two times their diameter, intervals more or less glabrous centrally, more or less indentated apically and basally, laterally very densely indentato-reticulato-punctate, surface rather dull.

*Elytra* oblong, about twice as long as wide, sides parallel, very feebly arcuate, apex broadly rounded, punctures rather coarse, separated by a distance equal to half to three times their own diameter, surface more or less irregular from feeble transverse impressions, punctures finer and more widely spaced toward apex.

*Abdomen* very finely and evenly punctured, more densely so on the fifth segment which is unmodified in the male.

*Legs* moderate in length and stoutness; femora rather stout, metafemora somewhat rapidly narrowed at the trochanters; tarsi rather long and slender.

*Male.*—Usually smaller. Fifth antennal joint elongate, oblong-triangular, broadly arcuate anteriorly, not noticeably wider than the following joints. Fifth ventral abdominal segment rather broadly sinuato-truncate.

*Female.*—Usually larger. Fifth antennal joint shorter, more triangular and more subangulate anteriorly; all the joints rather less robust. Fifth ventral broadly rounded at apex. Femora less stout and more parallel.

*Measurements.*—Length (Types), 3–3.3 mm.; width, 1–1.2 mm.

Holotype, male, in the collection of the California Academy of Sciences; allotype, female, and paratypes in that of the author.

*Type locality.*—Blood's Meadow, Alpine County, California; collected by the author on July 14th, 1907, at an elevation of 7000 feet. Beaten from the blossoms of a white *Ceanothus*, in company with *Amphichroum pallidum* Casey and another species of *Listrus* which is referred to *montanus* Casey. *Dilutus* is distinct in the similarity of the sexes, short dark pubescence and inconspicuous maculation. In *montanus* the pubescence and maculation are well developed, hairs rather long, form different in the sexes and more oval, and besides the antennae are distinctly incrassate, the eleventh joint is shorter, more robust, oval and wider than the preceding joints.

*Listrus martini*, new species.—*Form* somewhat elongate, more or less oblong-ovate, distinctly more than twice as long as wide. *Color* black, with a feeble purpureo-cupreous lustre, surface shining; mouth-parts pale rufo-testaceous, last two joints of the maxillary palpi blackish; first joint of the antennae black, second rufo-testaceous, succeeding joints similarly pale becoming gradually infuscate to tip; legs pale rufo-testaceous, femora rarely slightly infuscate.

*Pubescence* not dense, rather short and slender, more or less plumbeo-cinereous, with broad fasciae of nigro-fuscous hairs arranged as follows: A moderately wide transverse basal fascia, usually unbroken; post-basal fascia absent; a broad median fascia extending from margin to margin; a similar subapical fascia joining the median fascia along the suture; apical maculae absent. The median and subapical fasciae may by diffusion nearly coalesce, in such cases separated laterally by a narrow line of pale hairs, rarely distal two-thirds of the elytra are nearly dark. Pronotal lateral vittae not distinct; median dark area oblong-oval, extending from apical to basal margins, usually widest at middle and not constricted as in the hourglass figure. Head slightly maculate in the central area.

*Head* rather broad and relatively short, muzzle small; front broadly and feebly convex, sometimes feebly impressed behind the epistoma, with

a slight convexity at middle against the frontal suture; punctures rather small and sparse, slightly denser at the periphery; eyes relatively large, rather finely faceted, and moderately prominent. *Antennae* rather slender, last three joints rather heavy and not compressed; third joint rather slender and subcylindrical, fourth and fifth subangulate anteriorly, fifth slightly wider than the following three joints; sixth, seventh and eighth subequal; ninth and tenth about as long as wide and thicker; eleventh nearly as long as the preceding two taken together and pointed obovate.

*Pronotum* about a fourth wider than long, evenly and rather strongly convex from side to side, very feebly so antero-posteriorly; apex very feebly arcuate in circular arc, angles obtusely rounded; sides feebly arcuate, moderately converging toward apex, almost broadly and feebly sinuate adjacent to the angles, serrules small and acute, fimbriae moderately short, even and not dense; basal angles obtuse and rather distinct; base broadly and slightly arcuate; disk sparsely punctate in central third, punctures moderately small, separated by at least one or three times their diameter, intervals flat and smooth, rather strongly indentato-punctate in lateral thirds.

*Elytra* oblong, rather less than twice as long as wide; sides feebly arcuate and parallel, rather broadly rounded at apex; punctures rather sparse, at base equal in size to those of the pronotum, finer apically, surface slightly and sparsely rugose.

*Abdomen* finely and sparsely punctate, surface rather shining. Fifth ventral segment unmodified in the male.

*Legs* moderate in length; metafemora not in the least constricted behind and adjacent to the trochanters.

*Male.*—Narrower and oblong. Fifth ventral segment truncate at apex.

*Female.*—Slightly broader, more oblong-oval. Fifth ventral subangulate at apex and obliquely arcuate laterally.

*Measurements.*—Length (Types), 2.3–2.4 mm.; width, .9–1 mm.

Holotype, male, in the author's collection.

Allotype, female, in the collection of the California Academy of Sciences.

Paratypes in both collections and in that of Mr. J. O. Martin, who collected the species on April 13th, 1917.

*Type locality.*—Mecca, Colorado Desert, California.

*Distribution.*—Besides the specimens from the type locality, others in the Liebeck collection have been studied, these were collected in Utah. They agree in every particular with the types. A series of about thirty specimens have been studied.

*Martini* belongs to the same group of species as *annulatus, rubripes* and *parviceps* described below. In *rubripes* the antennae are stouter, surface lustre duller, and the pronotal central field is distinctly but not densely indentato-punctate and the sides are more strongly arcuate, it is found in Colorado. In *annulatus* the pronotal field is indentato-punctate and the antennae are dark. In both *rubripes* and *annulatus* the elytral dark fasciae are distinctly defined and do not tend to diffusion, as in *martini* and *parvicollis*. In *parvicollis* the pronotum is noticeably small. My series of *annulatus* are from the high Sierras, 7000 feet, and Mono Lake, Mono County, California.

*Listrus maculosus* Casey.—Very distinct from *amplicollis* Casey with which it is usually confused. In *amplicollis* the fifth ventral abdominal segment is modified on the disk, while in *maculosus* it is simple; in the latter the third, fourth and fifth antennal joints are distinctly compressed, large and triangular in form, the third joint is furthermore elongate and comparatively large and bears a distinct stout chitinous seta at apical border anteriorly in the male; the antennae have their usual form in the female.

*Maculosus* is taken abundantly about San Francisco and in Marin County. I took a very large series in Humboldt County, at Green Point Ranch and Willow Creek, in 1917. Casey mentions only having had a single male at the time of drawing up his description.

*Listrus vestitus*, new species.—*Form* elongate oval, distinctly more than twice as long as wide and moderately convex. *Color* black, surface more or less shining; second, third and fourth joints of the antennae pale, second always so, remaining joints more or less rufo-piceous, terminal ones usually quite black; mouth and basal joints of the palpi pale, epistoma more or less so; tarsi and distal half or two-thirds of the tibiae pale. A metallic lustre scarcely discernible, although the pronotum may be slightly subcupreous.

*Pubescence* distinctly cinereous, moderately long and recumbent. Maculae of dark brownish or blackish hairs are arranged on the elytra as follows: Basal fascia broken into a smaller humeral and a larger subscutellar macula on each elytron; post-basal fascia represented by a mid-elytral subquadrate macula, which rarely extends arcuately forward to the humeral forming a lunule; median fascia more or less narrow, distinctly and more or less sharply zig-zag, usually almost interrupted at the suture and on middle of each elytron; subapical fascia broader, usually interrupted at middle of each elytron, the median portions forming a more or less rhomboidal and usually rather large macula across the suture; apical maculae variable in size and form. Pronotal central macula more

or less constricted at middle, with reëntering slender median lines of paler hairs at apex and base; lateral lunules more or less distinct.

*Head* wider than the pronotal apex; frons more or less broadly impressed and usually a small glabrous area is present behind the base of the epistoma, punctures distinct and discrete, intervals somewhat indentato-punctate, surface rugulose at the epistoma. Eyes rather large and moderately strongly prominent. Antennae moderately long and different in the sexes.

*Pronotum* about a fourth wider than long, moderately and evenly convex, more strongly so anteriorly and laterally; apex arcuato-truncate and distinctly narrower than the base; apical angles rather broadly rounded; base broadly and rather strongly arcuate, angles not evident and almost continuously rounded with the broadly arcuate sides, which become less arcuate and moderately convergent to apex, serrations small and rather acute; disk rather discretely punctured in the central area, intervals flat and as wide or wider than the punctures, almost feebly indentate in part, lateral thirds densely rugoso-indentato-punctate.

*Elytra* oblong-oval, punctures rather smaller than on the pronotum, and separated by a distance equal to two times their diameter, somewhat smaller on apical third; surface more or less feebly transversely impresso-rugose; apex rather broadly rounded.

*Abdomen* quite densely punctato-rugulose; fifth ventral abdominal segment not modified on the disk.

*Legs* moderate in length and stoutness.

*Male.*—Narrower elongate oval. Smaller males not distinctly parallel. *Antennae* rather stout, outer three joints incrassate and not compressed; first joint about as long as wide, second a little longer than wide; third obconico-cylindrical, equal to the fourth in length; fourth subtriangular, obtusely angulate anteriorly, wider than the third; fifth a little longer than wide, triangular, distinctly wider than the next three following joints; sixth subtriangular, equal to the seventh in length; seventh less subtriangular; eighth less compressed than the preceding joints, a little longer than wide, more obconic than triangular; ninth, tenth and eleventh joints more robust; ninth as long as wide, sides oblique; tenth as long as wide and subquadrate in outline, circular in transverse section; eleventh wider than preceding joints, obtusely obovate and about a half longer than wide. Fifth ventral segment rather broadly and feebly sinuate at apex; surface rather asperately sculptured, hairs scarcely darker.

*Female.*—Somewhat broader. *Antennae* more slender, relative length and size of the joints similar; second and third rather elongate and equal in length, sixth not noticeably smaller than the seventh.

*Measurements.*—Length (Types), 3.2–3.4 mm.; width, 1.1–1.3 mm.

Holotype, male, allotype, female, in my own collection; paratypes in that of Mr. J. O. Martin, who collected them on June 5th, 1919.

*Type locality.*—Bear Lake, San Bernardino County, California. Eight specimens studied—four of each sex.

*Vestitus* is quite distinct from *elegantulus* and *bifasciatus*, where the males are distinctly elongate and parallel. In *vestitus* the differences in form between the sexes are less noticeable; the last three joints of the antennae are circular in section and stouter in the male.

*Listrus bifasciatus*, new species.—*Form* elongate, parallel to ovate, moderately convex. *Color* black, second to the sixth antennal joint inclusive piceous, second sometimes paler; tibiae and tarsi more or less piceous; surface scarcely feebly purpureo-aeneous in lustre and slightly shining.

*Pubescence* moderately short, not very conspicuous, brownish-black hairs about as abundant as the paler plumbeo-cinereous hairs and arranged in rather large maculae which appear as follows: A large parascutellar macula, an humeral elongate one extending arcuately backward and continuous with the post-basal at middle of the elytron, this macula varies in size; median fascia moderately wide and distinctly zig-zag, scarcely attaining the lateral margin, but extending forward along the suture, these extensions frequently separated and appearing as post-basal sutural maculae; subapical fascia similar in form, or divided at middle of each elytron, the sutural portions tending to form a subrhomboidal macula on the suture; apical maculae rather large. The elytral pattern is suggestive of that seen in *pardalis* Casey; the pale hairs form relatively narrow areas between the dark fasciae and maculae. Pronotal central macula quite distinctly constricted at middle and apparently somewhat different in the sexes; lateral semilunar vittae more or less distinct. Central area of the head usually darkish.

*Head* slightly broader than the pronotal apex, moderate in size, about as long as wide; front almost feebly convex, although feebly and broadly impressed anteriorly, punctures rather coarse and close, slightly impressed, intervals somewhat indented at the periphery, a small glabrous and slightly convex area at the epistoma. Eyes rather large. *Antennae* long, almost quite similar in the sexes, very feebly compressed, rather stout, very gradually incrassate, outer joints distinctly heavier; first very stout; second oval and a little longer than wide; third obconically subtriangular, almost twice as long as wide; fourth wider than the fifth or sixth, slightly elongate, triangular and angulate anteriorly, and with the fifth noticeably compressed; fifth similar to the fourth but obtuse

anteriorly; sixth about as long as wide and obtusely rounded anteriorly; seventh and eighth subtriangular, about as long as wide, almost circular in transverse section; ninth and tenth similar in form but slightly longer; eleventh less than twice as long as wide, slightly obovate, obtusely rounded at apex. All joints beyond the third are quite abundantly set with rather stiff and moderately short hairs.

*Pronotum* about a fourth wider than long; apex arcuato-truncate, apical angles broadly rounded into the sides, the latter broadly arcuate in basal half, thence less so and converging moderately to apex, serrules short and rather broad, not very distinct; base broadly arcuate, rounding into the sides, angles absent; disk widest behind the middle, quite evenly convex, somewhat declivous antero-laterally, punctures moderate in size, well defined, separated by a distance equal to one or two times their diameters, in central third the intervals are flat, glabrous, not noticeably indented, lateral thirds strongly indentato-reticulato-punctate.

*Elytra* elongate, punctures rather smaller than those of the pronotum, almost arranged in irregular transverse lines of twos or fours, separated by a distance equal to one-half to three times their diameters, intervals between the punctate lines more or less feebly and transversely impressed, surface very finely rugulose.

*Abdomen* very finely and almost thickly punctate; sixth ventral segment usually visible; apex with rather long and slightly blackish pubescence; fifth ventral unmodified on the disk in the male.

*Legs* moderate in length and stoutness; tarsi long and slender.

*Male.*—Narrow and parallel. Second and third antennal joints stouter than in the female; pronotal hourglass-shaped macula with narrow median lines of pale hairs at apex and base; fifth ventral segment broad at apex and truncate.

*Female.*—Elongate ovate, sides rather feebly arcuate, second and third antennal joints less stout; pronotal central macula usually without median pale lines; fifth ventral broadly rounded at apex.

*Measurements.*—Length (Types), 3–3.6 mm.; width, 1–1.4 mm.

Holotype, male, and paratypes in my own collection; allotype, female, and paratypes in the collection of the California Academy of Sciences.

*Type locality.*—Vine Hill, near Martinez, Contra Costa County, California. Collected by myself on November 28th, 1908. About twenty specimens studied.

*Distribution.*—California.—(Besides at the type locality, specimens have been seen from Alhambra Valley, Contra Costa County; these were collected on December 25th, 1913; Niles Canyon, Alameda County, April 19th, 1914.)

Apparently related to *fidelis* Casey, from which it differs in the fourth antennal joint being wider and more prominent anteriorly than the fifth, shorter pubescence and two distinct elytral fasciae; pubescence not dense and coarse, the elytral pattern somewhat resembles that seen in *pardalis* Casey.

*Listrus simplex*, new species.—*Form* parallel to subovate and moderately convex. *Color* black, more or less shining and with a slight viridoaeneous lustre; antennae rufo-testaceous throughout, frequently the distal joints are more or less rufo-piceous; tibiae and tarsi more or less rufous.

*Pubescence* short, somewhat sparse and rather less than coarse, cinereous in color, with dark fasciae of brownish-black hairs arranged as follows: A basal that may be narrowly interrupted at the scutellum; post-basal maculae absent or small at middle of each elytron; submedian fascia rather wide with edges more or less slightly irregular; the subapical likewise rather wide, entire or interrupted by a few pale hairs on the suture; apical maculae small or obsolete. Pronotal maculae apparently more or less different in the sexes; lateral semilunar vittae more or less evident, sometimes very narrowly separated from the central macula.

*Head* about as long as wide, moderately finely punctate, punctures slightly sparse, intervals almost smooth or feebly indentato-rugulose; front slightly concave, impression broad, with a small median almost glabrous convexity at the epistomal base. *Antennae* extending to about the pronotal base and quite similar in the sexes, rather stout and somewhat incrassate, feebly compressed to about the tenth joint; second, third and fourth joints subequal in length; second oval, about as wide as the fifth; third subcylindrical; fourth feebly angulate anteriorly; fifth subtriangular, wider than the two preceding and following joints, as wide as the ninth, apical angle prominent anteriorly; sixth and seventh similar in length and form, the former slightly smaller and obconico-triangular; eighth oblong-obconic; ninth slightly wider and almost subquadrate; tenth oblong-triangular and slightly transverse; eleventh suboblong-oval, about a half longer than wide; joints from the sixth to the eleventh gradually increasing in width; outer joints rather abundantly set with pale hairs.

*Pronotum* a little wider than long, strongly convex from side to side, widest behind the middle; sides evenly arcuate in basal half, thence feebly arcuate and moderately convergent to apex, serrules small; base broadly and slightly arcuate, apparently rather briefly and obliquely sinuate within the obtusely rounded basal angles; apical angles obtusely rounded; apex broadly and feebly arcuate; disk with moderately small punctures, separated by a distance equal to their diameter in the central area from

apex to base, intervals rather smooth, although very feebly indentato-punctate, densely reticulato-punctate laterally.

*Elytra* about twice as long as wide, oblong; sides parallel to feebly divergent posteriorly, apex broadly rounded; punctures of the disk rather coarse and separated by a distance equal to one or three times their diameter, finer and more widely spaced toward apex.

*Abdomen* finely and not noticeably densely punctate, except on the fifth segment, which is unmodified on the disk in the male.

*Legs* slightly elongate, femora subparallel.

*Male.*—Rather elongate, parallel and narrower. Pronotal central macula more or less oval. Antennae slightly stouter. Abdomen more coarsely punctate toward the apex; fifth ventral segment truncate at apex.

*Female.*—Subparallel, stouter and slightly wider posteriorly; sides very feebly arcuate. Pronotal central macula more or less hourglass-shaped, anterior lobe about reaching to the apical margin, posterior lobe with a short reëntering median line of pale hairs; lateral semilunar lines rather indefinite. Fifth ventral rounded at apex.

*Measurements.*—Length (Types), 2.0–3.0 mm.; width, .8–1.1 mm.

*Type locality.*—Marsh Ranch, Green Point, Humboldt County, California.

Holotype, male, and paratypes in my own collection; allotype, female, in that of the California Academy of Sciences.

*Habitat.*—California (on Green Point and Redwood Creeks, Humboldt County, in June; in May, F. W. Nunenmacher; Del Norte County, F. W. Nunenmacher; Duncan Mills, Sonoma County, June, F. E. Blaisdell).

Number of specimens studied, 29.

*Variations.*—Antennae and legs may be piceous. The basal dark fascia of the elytra may be dissolved into a juxta-scutellar macula on each side, and a humeral lunule that may join the post-basal macula.

*Simplex* in color and maculation resembles *annulatus*, but is more elongate and less stout, with pronotum narrower. In *annulatus* the basal fascia is usually rather widely interrupted at the scutellum and suture and no variations have been observed.

*Listrus incestus*, new species.—*Form* elongate, oblong-oval and moderately convex. *Color* black, appendages nigro-piceous, second joint of the antennae pale, terminal joints black; surface somewhat shining, lustre more or less feebly purpureo-cupreous anteriorly.

*Pubescence* short and decumbent, argenteo-cinereous in color and arranged in maculae and fasciae of brownish hairs on the elytra as follows: A broken basal fascia, forming a small humeral and parascutellar macula on each elytron, usually small but variable in size; a post-basal

macula usually extending forward to the humeral forming a lunule; a rather wide entire median fascia with slightly zig-zag edges, sometimes tending to extend basalward along the suture; a similar but usually slightly narrower subapical fascia, and an apical varying in size, sometimes involving the apex. Pronotal median macula constricted at middle, frequently with a short reëntrant and median line of pale hairs at apex and base; lateral vittae narrow or broader. Frontal region of the head sometimes darkish.

*Head* about as long as wide. Front feebly and broadly concave, scarcely convex in the median line behind the epistoma, surface densely indentato-punctate. *Antennae* extending a little beyond the pronotal base, not noticeably slender, feebly compressed; second joint oval, almost as wide as long; third cylindrico-obconical, scarcely longer than the second; fourth noticeably subangulate anteriorly; fifth wider, distinctly angulate, sides unequal, apical margin oblique; sixth smaller, as long as wide, obtusely rounded anteriorly; seventh oblong-triangular and about as long as wide; eighth similar and slightly thicker; ninth subtriangular and slightly wider than long; tenth scarcely wider than long, sides arcuate; eleventh oblong-oval, apex obtusely rounded, about a half longer than wide; last four joints gradually incrassate.

*Pronotum* about a fifth wider than long, evenly convex; apex arcuato-truncate, apical angles distinctly rounded; base broadly arcuate, angles obtuse, small and more or less reflexed, sometimes scarcely discernible; sides strongly and evenly arcuate in basal half, thence straighter and moderately converging to apex, serrules equal, rather thick and subobtuse, almost equally spaced; fimbriae moderately long and not dense; disk densely indentato-punctate. Sometimes the sides are very briefly sinuate before the basal angles.

*Elytra* oblong-suboval, twice as long as wide; base truncate, apex rather broadly rounded; punctures rather coarse, separated by a distance equal to once or twice their own diameter, finer toward apex; surface somewhat transversely impresso-rugose.

*Abdomen* densely and finely sculptured. Fifth ventral segment unmodified in the male.

*Legs* not stout. Femora subparallel; surface finely punctato-rugulose.

*Male.*—Narrower. Fifth ventral truncate at apex.

*Female.*—Somewhat broader, slightly wider posteriorly. Antennae similar to those of the male, but rather less stout. Fifth ventral rather broadly rounded at apex.

*Measurements.*—Length (Types), 2.5–3.2 mm.; width, 1–1.2 mm.

Holotype, male, and allotype, female, in the author's collection.

Collected by Mr. J. O. Martin, who possesses paratypes.

*Type locality* and *habitat.*—Bear Lake, San Bernardino County, California. Collected May 5, 1919.

*Remarks.—Incestus* resembles both *simplex*, n. sp., and *incertus* Casey. In *incertus* the sexes are shorter and rather more robust, the male being rather more oblong; centrally the pronotal disk is simply punctate, antennae slenderer, joints five to ten triangular, tibiae and tarsi pale.

*Simplex* has the central area of the pronotum simply punctate; antennae more compact, fourth joint somewhat shorter than the third and distinctly obconical, fifth scarcely wider and feebly angulate anteriorly; elytral dark fasciae rather broader and straighter, tibiae, tarsi and antennae more or less pale.

In *difficilis* the third joint of the antennae is cylindrical, the fifth longer than wide, distinctly wider, sixth and following joints distinctly shorter than the fourth. Central area of the pronotal disk not densely indentato-punctate.

*Listrus giffardi*, new species.—*Form* oblong-oval, subparallel, slightly elongate and very moderately convex. *Color* black, upper surface of body with a more or less noticeable aeneous lustre; antennae rufous, blackish distally; legs rufous throughout.

*Pubescence* moderately short, not coarse, recumbent, moderate in abundance and plumbeo-cinereous in color; slightly longer on the under surface of the body, scarcely paler anteriorly. Elytral dark-brownish hairs arranged in maculae and fasciae as follows: An elongate narrow humeral and a broader posteriorly elongate parascutellar macula on each elytron; a post-basal small macula at middle on each side; submedian and subapical transverse fasciae rather wide with edges irregular; apical maculae rather large and distinct. Pronotal pubescence similar to that on the elytra, maculae obscure, central constricted figure and moderately wide lateral vittae feebly evident; front of head darkish in the central area.

*Head* about as long as wide, not large, eyes moderately prominent and evenly convex; front feebly and broadly impressed, punctures moderately coarse, rather sparse, intervals smooth and obsoletely indentate; muzzle small. *Antennae* rather long and somewhat slender, moderately compressed; second joint oval, not stout, not twice as wide as the third, the latter cylindrical, more than twice as long as wide, equal to the fourth in length; the latter obconical, slightly prominent anteriorly at apex; fifth about a half longer than wide, not widely triangular, about as wide as the eighth or ninth, apical margin oblique, moderately prominent anteriorly; sixth and seventh subequal in length and size, almost a little longer than wide, apical margin oblique; eighth to the tenth tri-

angular, slightly longer than wide, increasing very slightly in width and size in the order named; eleventh almost evenly oval, slightly narrowed apically, about twice as long as wide.

*Pronotum* a little wider than long, widest just behind the middle, length equal to breadth of the head across the eyes; apex arcuato-truncate in circular arc; apical angles rounded; sides not strongly arcuate in basal half, slightly sinuate before the basal angles, anteriorly rather straight and moderately convergent to apex, serrules small, not very distinct although a few may be larger and subacute, fimbriae moderate in length; base broadly arcuate, feebly sinuate laterally; basal angles obtuse and more or less distinct; disk rather strongly convex, rather strongly arcuately declivous antero-laterally, sides feebly impressed within the basal angles and laterally anteriorly, punctures moderate in size, rather sparse in the central two-fourths, intervals flat, rather smooth, apparently obsoletely indentate, lustre rather dull, in lateral fourths not strongly nor very densely reticulato-punctate.

*Elytra* oblong-oval, twice as long as wide and parallel; humeri not prominent; disk rather distinctly transversely impressed behind the base, punctures rather indentated and thereby appearing coarse, separated by rather less than twice their own width and slightly arranged in transverse rows, with the intervals feebly and transversely impressed giving the surface the appearance of being subrugose, surface smoother apically with the punctures finer; apex evenly but not very broadly rounded.

*Abdomen* very finely and densely punctulate and microscopically reticulate, less than moderately convex.

*Legs* moderate in length and stoutness.

*Salient male characters.*—Subparallel and elongate, moderately narrow; sides of the fifth ventral segment moderately convergent posteriorly, apex equal in width to about a third of the base and truncate at tip; surface not in the least modified, apical tactile setae noticeably few.

*Female unknown.*

*Measurements.*—Length, 3 mm.; width, 1 mm.

Holotype, male, in my own collection; collected on June 9, 1917, by Mr. Walter M. Giffard of Honolulu, Hawaii.

*Type locality.*—Santa Cruz County, at an elevation of 600 feet.

*Giffardi* is peculiar in its sparsely punctured pronotum and entirely pale legs, the elytral maculation is different from that observed in *luteipes* to which it is apparently related, the fasciae being more sharply defined and the basal maculae sharper and more elongate, and besides the pronotum is narrower than in that species where the male is more ovate in form. I take pleasure in naming this species after its discoverer, Mr. Giffard.

*Listrus parvicollis*, new species.—*Form* elongate subovate, moderately convex. *Color* black with a faint purpureo-aeneous lustre; labrum more or less rufous, head and pronotum opaque, antennae piceo-rufous, joints two, three and four more rufous than the terminal ones, elytra more or less shining; femora rufo-piceous, tibiae and tarsi rufous.

*Pubescence* short and sparse, dark cinereous in color with brownish hairs arranged in a pattern as follows: A broad median fascia that extends along the suture to base and dilating about the scutellum, the humeral and lateral area with irregular grayish markings; a wide subapical fascia that involves most of the apex, where there are scattered grayish hairs. The median and subapical fasciae are separated by a very narrow transverse zig-zag fascia of pale hairs. Pronotal central macula very faintly indicated, but apparently constricted at middle and with a narrow median grayish line; lateral semilunar vittae more or less obsolescent.

*Head* notably small, about as wide as long, muzzle small and relatively narrow; front moderately impressed, impressions broad and separated by a feeble but distinct, glabrous raised area behind the base of the epistoma; surface densely punctato-rugose, eyes rather prominent. *Antennae* extending to the base of the pronotum, rather slender and somewhat incrassate; second joint oval and rather stout; third cylindric and about twice as long as wide; fourth, fifth and sixth distinctly angulate on their anterior borders; fifth distinctly wider than the fourth but subequal in width with the sixth; seventh, eighth, ninth and tenth not stout, but evidently slightly transverse; eleventh oval and obtusely pointed and about a half longer than wide.

*Pronotum* notably small, about a third wider than long; sides evenly and rather strongly rounded in basal half, thence straight and convergent to apex, and coinciding with the inner border of the eyes, serrules small and acute, fimbriae not close and moderately short; apical angles obtuse; apex rather arcuate and distinctly narrower than the head; base broadly rounded, continuously so with the sides; disk very densely indentato-punctate, indentations same size as the punctures, the deeper punctures separated by one or two indentations; surface rather strongly and evenly convex from side to side, especially anteriorly.

*Elytra* distinctly wider than the pronotum, slightly more than twice as long as wide; sides broadly and not strongly arcuate; apex rather broadly rounded; disk not very coarsely punctate, punctures separated by a distance about equal to twice their own diameter, finer toward apex.

*Abdomen* very finely punctate and more or less finely reticulate.

***Male unknown.***

*Female.*—Fifth ventral abdominal segment rounded at apex, tip deflexed, surface with a small but distinct impression in front of the deflexed margin.

*Measurements.*—Length, 2.4 mm.; width, .9 mm.

Holotype, female, in my own collection.

*Type locality.*—Mokelumne Hill, Calaveras County. Collected in May. A single specimen studied. A very distinct species in the characters of the head, pronotum and elytral maculation.

*Listrus trochantericus,* new species.—*Form* slightly robust, oblong-ovate, rather more than twice as long as wide. *Color* black; tibiae and tarsi rufo-testaceous, tibiae at base and tarsi toward tip, blackish; second joint of the antennae rufo-testaceous, first joint black as usual, remaining joints rufo-piceous, last two or three may be quite black.

*Pubescence* rather dense and coarse, almost concealing the general surface, cinereous in color, with brownish-black maculae and fasciae arranged on each elytron as follows: A rounded parascutellar macula and a humeral lunule more or less interrupted behind the umbo, umbonal dot small or absent, apical portion feebly arcuate, appearing as a post-basal macula; a narrow transverse fascia a little behind the middle, slightly zig-zag, and interrupted at the suture, often broken into two maculae on each elytron; subapical transverse fascia similar in form; apical macula present or absent. Pronotal pattern consists of lateral semilunar vittae and a somewhat constricted central figure, the former broken into two and the latter more or less dissolved into four parts. Central area of the head submaculate. Maculae of the head and pronotum not very distinct.

*Head* slightly transverse, front rather broadly impressed, or longitudinally impressed within the eyes, with a feeble central longitudinal convexity, punctures not coarse, rather crowded in the impressions, somewhat sparse elsewhere, intervals scarcely indented, a small impunctate area at base of the epistoma; muzzle short, margin evenly arcuate from side to side. *Antennae* rather slender, feebly incrassate, outer joints noticeably heavier, slightly compressed; third cylindrical, fourth obconico-triangular, both slightly elongate; fifth serrate, a little wider than the sixth, sixth to the tenth inclusive, subtriangular.

*Pronotum* less than a fourth wider than long; sides evenly and rather strongly arcuate, moderately convergent anteriorly and less arcuate, serrules not strong; basal angles not evident and well rounded; base broadly arcuate; disk evenly convex, more strongly so anteriorly, closely punctate, punctures moderate in size, separated by a distance more or less equal to their diameter, intervals scarcely indented in the central area, but

densely indentato-punctate in the lateral two-fifths, lustre dull; fimbriae moderate in length, even and cinereous in color.

*Elytra* oblong, less than twice as long as wide and a little wider posteriorly; sides feebly arcuate, subparallel, moderately convex on the disk; punctures separated by a distance equal to about twice their diameter, at base subequal to those of the pronotum, finer apically and more widely spaced; apex rather broadly rounded.

*Abdomen* finely and rather sparsely punctate; surface extremely finely rugulose; pubescence slightly longer and finer. Fifth ventral segment modified on the disk in the male.

*Legs* moderate in length and stoutness. Metatrochanters triangular; femora quite cylindrical behind the trochanters and more or less arcuate.

*Male.*—Narrower. Metatrochanters subacute on their inner angle; femora more strongly cylindrical and arcuate behind the trochanters. Fifth ventral segment shorter and evidently sinuato-truncate at apex; hairs of the genital segment more or less brownish or blackish.

*Female.*—Broader. Metatrochanters rounded on their inner angle; femora less cylindrical and arcuate at base; fifth ventral longer with the margin broadly rounded at apex.

*Measurements.*—Length (Types), 2.5–3 mm.; width, .9–1.1 mm.

Holotype, male, and allotype, female, in my own collection. Paratypes in my own and that of Mr. J. O. Martin.

*Type locality.*—Bear Lake, San Bernardino County, California. Collected by Mr. J. O. Martin, on May 5, 1919. A series of twenty specimens studied.

*Trochantericus* differs from all known species in the form of the metatrochanters and metafemora. The elytral fasciae are usually broken up into rounded or slightly transverse maculae, never attaining the suture in the series at hand. The central dark figure of the pronotum may be broken up or shaped like two U's with their bases together.

*Listrus liebecki,* new species.—*Form* distinctly oblong-oval and moderately convex. *Color* very black, with a more or less dark viridometallic lustre; basal joints of the palpi and mandibles more or less rufopiceous; second antennal joint rufous, the four following joints more or less dark rufo-piceous; tarsi and distal half of the tibiae more or less dark rufous to rufo-piceous.

*Pubescence* sparse, short, closely recumbent and very inconspicuous, dark plumbeous in color, dark areas clothed with very dark-brown hairs. Maculation very obscure and apparently consists of rather broad fasciae and maculae arranged as follows: A large parascutellar and a smaller humeral macula on each elytron; a post basal macula at middle of each;

a median and subapical fascia, the latter very indefinite; apical maculae not discernible in the type. Pronotal central macula apparently oval, lateral semilunar vittae not discernible. Hairs on the head more or less diffusely brownish; those on the prosternum longer and more cinereous, elsewhere beneath similar in length but somewhat darker.

*Head* slightly transverse, distinctly wider than the pronotal apex; eyes moderately large and prominent; front broadly impressed, a small and convex, median and more or less glabrous area just behind the epistomal base; punctures rather coarse, well defined and rounded, intervals more or less indented. *Antennae* moderately long, slightly stout, scarcely incrassate; second joint oval, about a half longer than wide, rather less than half the width of the first; third joint cylindrical, scarcely longer than the second, slightly widest at apex; fourth feebly compressed, subtriangular, not prominent anteriorly, about a half longer than wide; fifth slightly compressed, subtriangular, about a fourth longer than wide, wider than the four following joints, apical angle prominent anteriorly; sixth, seventh, and eighth subtriangular, less compressed, about as long as wide; ninth similar in form and a little longer; tenth slightly stouter, more oblong, very slightly longer than wide; eleventh almost oblong-oval, rather less than twice as long as wide, not strongly narrowed at apex.

*Pronotum* about a fourth wider than long, rather evenly convex; apex arcuato-truncate; apical angles rather broadly rounded into the sides, the latter broadly arcuate, rather more strongly so in basal half, converging moderately to apex, serrules small, rather widely spaced, subacute, fimbriae moderate in length and plumbeo-cinereous in color; base broadly arcuate and not strongly lobed, sinuate laterally; basal angles obtuse and distinct; disk moderately coarsely punctate in the central area, intervals about equal to the diameter of the punctures, indentato-punctate apically and basally, laterally very densely indentato-reticulato-punctate.

*Elytra* oblong, about twice as long as wide, base rather broadly emarginate, scutellum transversely oblong; disk rather coarsely punctate, punctures somewhat shallow, separated by a distance equal to one or two times their diameter, a few coalescing transversely producing a somewhat but slight rugoseness, punctures finer toward apex, the latter rather parabolically rounded.

*Abdomen* rather densely punctate; fifth ventral segment modified in the male.

*Legs* rather short and moderate in stoutness.

*Male.*—Fifth ventral distinctly modified, apex rather deeply sinuate, adjacent surface somewhat impressed, impression limited by denser punctuation, hairs slightly coarser, but pale in color, or at least very slightly

darker about the abdominal apex; metafemora thickened and apparently arcuate, sides at apical third moderately swollen.

*Female unknown.*

*Measurements.*—Length, 3.2 mm.; width, 1.1 mm.

Holotype, male, in my own collection; paratypes in that of Mr. Chas. Liebeck.

*Type locality.*—Fort Collins, Colorado. Only known from the type locality.

Remarkably distinct from *interruptus* and the unicolorous species of the same region. It has not been possible to study the metatrochanters on account of their being hidden by glue and the lack of specimens for dissection.

*Listrus olympianus*, new species.—*Form* elongate suboval, slightly robust and rather strongly convex. *Color* deep black with a slight bluish metallic lustre; head and pronotum feebly purpureo-aeneous; tarsi and tips of the tibiae somewhat rufo-piceous; second antennal joint more or less rufous, third joint rufo-piceous.

*Pubescence* of less than moderate length, rather sparse, mouse-colored and in certain lights flavo-plumbeous, dark areas difficult of determination. Basal fascia broken into two maculae on each elytron, the humeral small and the parascutellar larger; post-basal represented by an indefinite macula at middle of each elytron; median fascia irregularly and obscurely transverse; subapical fascia transverse, entire or broken and rather indefinite; apical maculae more or less obscure. Maculations are moderately wide as a rule. Pronotal median macula constricted at middle, faintly incised anteriorly and posteriorly on the median line; lateral semilunar vittae distinct or more or less atrophic. Pronotal fimbriae not long nor close and cinereous in color.

*Head* rather large and slightly wider than the pronotal apex; front broadly impressed between the eyes, a feeble median longitudinal convexity is discernible; rather closely and distinctly punctate, intervals obsoletely indentate, antennal convexities punctato-rugose; muzzle short with sides convergent. *Antennae* reaching to about the pronotal base, not distinctly incrassate and dissimilar in the sexes, slightly compressed, clothed rather thickly with short, stiff grayish hairs; joints rather densely punctate.

*Pronotum* about a fourth wider than long, very slightly narrower than the elytral base; sides rather evenly and moderately arcuate in basal half, less so anteriorly and slightly converging and rounding into the apex, the latter arcuato-truncate at middle, serrules rather coarse; basal angles obtusely rounded; base arcuate; disk moderately strongly convex, less so

across the base, more declivous antero-laterally, punctures rather coarse, separated by a distance about equal to their diameter, intervals smooth and shining, in the central area obsoletely indentate, not widely indentato-punctate along apex and base, laterally rather widely and densely indentato-rugoso-punctate; apex slightly narrower than the base.

*Elytra* about twice as long as wide; sides parallel, very feebly arcuate, somewhat wider posteriorly; apex rather broadly rounded, sutural angles obtusely and narrowly rounded; punctures rather coarse, separated by a distance two or three times their diameter, surface very finely crinkled.

*Abdomen* finely punctate; fifth segment quite densely so and different in the sexes.

*Legs* moderate in length and stoutness.

*Male.*—Similar in form to the female although slightly narrower. *Antennae* stouter, second joint globular; third narrowest and obconical, about equal in length to the fourth; the latter triangular, distinctly wider, equal in width to the sixth or seventh, apex transverse; fifth slightly longer and subtriangular, broader than the fourth, sixth or seventh, anteriorly prominent; sixth and seventh about as long as wide, subtriangulo-obconical; eighth rather more triangular and a little longer; ninth about as long as wide, rather subtriangular and with sides more arcuate; tenth almost as wide as long, widest joint of all but not suddenly so, almost quadrato-triangular in outline; eleventh narrower, about as wide as the ninth, a half longer than wide, tapering gradually in apical half and almost subfusiform. Fifth ventral segment moderately broad at apex, distinctly sinuato-truncate, adjacent surface rather glabrous and impressed, sides of the impression rather more prominent, pubescence longer, somewhat denser and more conspicuous, in part blackish at margins and on the genital segment; longer tactile hairs rather abundant.

*Female.*—Scarcely stouter. *Antennae* moderately slender, second joint slightly less globular; third subtriangular and comparatively narrow; fourth, sixth, seventh and eighth subtriangular, slightly longer than wide; fifth slightly longer than wide, subtriangular, apex rather oblique and distinctly angulate anteriorly, scarcely as wide as the ninth; ninth and tenth subtriangular, about as long as wide, sides of the tenth moderately arcuate; eleventh obovate, wider than the tenth, about a half longer than wide. Fifth ventral rather broadly rounded at apex. Pubescence longer, denser and darker about the abdominal apex.

*Measurements.*—Length (Types), 3.1–3.4 mm.; width, 1.0–1.2 mm.

Holotype, male, and allotype, female, in my own collection; paratypes in that of Mr. Chas. Liebeck.

*Type locality.*—Olympia, Washington State. Eight specimens studied.

*Remarks.—Olympianus* is evidently rather closely related to *dilutus*, from which it differs in the stouter and shorter antennae, flatter and scarcely impressed front, and in the male the fifth ventral is modified. In *dilutus* the same segment is squarely truncate and narrowly beveled on the margin in middle third. The maculae in *dilutus* tend to transverse fasciae, in both they are equally difficult of determination. In *liebecki* the second antennal joint is elongate, in *olympianus* it is globular—as long as wide.

*Listrus occidens*, new species.—*Form* comparatively small, oblong-oval, subparallel and moderately convex. *Color* black, with a distinct aeneous lustre; mouth parts more or less rufo-testaceous, palpi more or less black; antennae, tibiae and tarsi rufo-testaceous; femora at times slightly rufescent apically.

*Pubescence* moderately short, abundant but not completely hiding the body surface, recumbent, plumbeo-cinereous in color; longer on the under surface of the body, snowy white on the head, sterna and their side pieces; slightly darker on the abdomen but snowy on the apex. Dark brown hairs of the upper surface reduced to a minimum, maculation of the elytra nearly obsolete; a basal parascutellar dot and a very small post-basal macula at middle of each elytron; submedian and subapical fasciae represented by indefinite small maculae, apical dots obsolete. Pronotal maculae indefinite, central figure apparently constricted at middle; lateral vittae broken into two dots each, the anterior of which appears as a rounded macula in the antero-lateral quadrant of the disk.

*Head* about as long as wide, eyes large and rather strongly convex; front broadly impressed, feebly convex on the vertex, punctures moderately large, rather sparse, denser toward the epistoma, intervals feebly rugulose and rather shining; white hairs on the muzzle and anterior canthi of the eyes rather conspicuous. *Antennae* moderately long, extending to about the pronotal base, three apical joints rather stout and quite circular in transverse section, intermediate joints moderately compressed; second joint oval, about as long as wide; third slender and cylindrical, about as long as the second or the fourth, the latter subtriangular and rather prominent anteriorly; fifth slightly elongate, apparently constricted at base and as wide as the ninth, anterior margin prominent and arcuately rounded; sixth and seventh triangular, subequal and as long as wide; eighth apparently wider than long and subtriangular; ninth subtriangular with sides somewhat arcuate; ninth and tenth a little stouter, about as long as wide, sides arcuate; eleventh short ovate, less than a half longer than wide.

*Pronotum* about a fourth wider than long, widest behind the middle; apex feebly arcuate in circular arc; sides evenly and rather moderately

strongly arcuate in posterior half, thence rather straight and somewhat strongly convergent to apex as viewed from above, serrules small and subacute, fimbriae cinereous and moderate in length; apical angles obtusely rounded; base broadly arcuate, feebly sinuate laterally; basal angles represented by a denticle, otherwise rounded; disk evenly and moderately convex posteriorly, arcuately and strongly declivous antero-laterally; punctures in the central area moderate in size and separated by a distance equal to about one or two times their diameter, intervals slightly rugulose, or very obsoletely indentate, laterally not very coarsely reticulato-punctate.

*Elytra* oblong, about twice as long as wide, rather evenly convex from side to side; disk moderately closely punctate, punctures not strongly outlined, separated by a distance equal to one or two times their diameter, surface somewhat feebly transversely rugose; punctures finer and more widely spaced toward apex, the latter evenly rounded.

*Abdomen* finely and densely punctured; fifth ventral segment modified on the disk in the male.

*Legs* moderate in length and stoutness; metafemora somewhat constricted at base.

*Male.*—Parallel, slightly elongate. Fifth ventral distinctly sinuate, slightly blackened on the impressed area, hairs pale and normal elsewhere.

*Female unknown.*

*Measurements.*—Length, 2.6 mm.; width, .9 mm.

Holotype, male, in my own collection.

*Type locality.*—San Diego, California, without other data. Collected by Mr. O. N. Sanford.

*Occidens* is quite distinct in its feebly marked elytral maculation, rufous antennae, tibiae and tarsi, modified fifth ventral segment of the abdomen, ashy pubescence and several other minor differences.

*Listrus angulatus*, new species.—*Form* oblong-ovate, about three times as long as wide and moderately convex. *Color* black, feebly shining, with a very slight aeneous lustre anteriorly; tarsi and distal part of the tibiae dark rufo-piceous; antennae nigro-piceous throughout.

*Pubescence* abundant, conspicuous, moderate in length and coarseness, recumbent, longer on the under surface of the body, plumbeo-cinereous in color and somewhat silvery on oblique inspection. The dark brownish hairs are arranged in more or less discrete maculae as follows: Basal maculae obsolete, or a small humeral and a parascutellar which in some instances coalesce on each elytron remaining rather widely interrupted at the scutellum; post-basal macula variable in size at middle of each elytron; a submedian fascia which is very narrow and zig-zag, or

broken into two maculae on each side, of which the lateral may be obsolete; a subapical transverse row of four maculae that seldom unite on the suture; apical maculae obsolete or variable in size. Pronotal central figure dissolved into four maculae that may unite more or less to form lobes or an almost constricted macula; lateral vitta broken into two dots, it is seldom entire.

*Head* relatively small, wider than the pronotal apex, about as long as wide; eyes large, only moderately prominent; front broadly and not strongly impressed, feebly convex on the vertex, punctures scarcely coarse, dense anteriorly and more widely spaced on the vertex, muzzle short. *Antennae* similar in the sexes, moderate in length, feebly compressed, apical joints somewhat circular in transverse section, joints four and five noticeably compressed; second joint rather stout, subglobular, very slightly longer than wide, about as wide as the eighth; third about as long as the second, about half as wide, obconico-cylindrical; fourth subtriangular, slightly longer than wide, apical margin oblique, prominent anteriorly; fifth nearly as wide as the tenth, subtriangular, slightly longer than wide, apical margin slightly oblique, anterior margin prominent but not sharply angulate; sixth to the ninth similar in form, subtriangulo-moniliform and subequal in length; tenth stouter, about as long as wide, subtriangular in outline as viewed from above; eleventh scarcely twice as long as wide, obovate, equal in width to the tenth.

*Pronotum* about a third wider than long, rather evenly convex, a little more declivous antero-laterally; apex subtruncate in moderately circular arc; sides broadly arcuate, less so anteriorly and moderately convergent to apex, serrules small, subacute and rather widely spaced, fimbriae moderate in length and coarseness, not very close; apical angles subobtusely rounded; base broadly arcuate, almost moderately sinuate laterally within the angles, which are evident but not strong; disk dull in lustre, at center not very densely asperately indentato-punctate, strongly so laterally.

*Elytra* oblong-oval, humeri rather prominent; sides rather moderately arcuate, apex rather broadly rounded; disk not strongly punctate, punctures rather shallow, separated by a distance equal to one or two times their diameter, finer and sparser toward apex.

*Abdomen* densely and finely punctate, surface rather microreticulate; fifth ventral segment modified on the disk in the male.

*Legs* somewhat slender, femora rather moderate in stoutness.

*Male.*—Subparallel, oblong-subovate; fifth ventral segment rather short and broad, distinctly sinuate at apex, lateral angles moderately rounded, sinus rather feebly rounded at bottom where the edge is slightly beveled; adjacent surface more or less glabrous and the surrounding

hairs not modified, although brownish in color and slightly denser than on the preceding segments.

*Female.*—More robust, oblong-ovate; fifth ventral segment rather long, only moderately broad and rather strongly rounded at apex.

*Measurements.*—Length (Types), 3.5–4.0 mm.; width, 1.3–1.4 mm.

Holotype, male, and paratypes in my own collection; allotype, female, in that of the California Academy of Sciences.

*Type locality.*—Mono Lake, Mono County, California; collected by Mr. Chas. L. Fox, on June 17, 1917. Seven specimens studied.

*Angulatus* differs from the other species in its dark antennae, distinct basal angles of the pronotum, stouter ovate form and simple modification of the disk of the fifth ventral in the male. It resembles *montanus* Casey in appearance.

*Listrus salicis*, new species.—*Form* oblong-oval, similar in the sexes and moderately convex. *Color* black, dull in lustre with a feeble aeneous tinge; mouth-parts piceous; second joint of the antennae rufous, third, fourth and fifth joints more or less rufo-piceous, apical joints black; tibiae and tarsi piceous, the latter may be rufo-piceous.

*Pubescence* rather coarse, linearly subsquamiform, rather short and recumbent, quite dense, plumbeo-cinereous on the upper surface; longer on the under parts, dense and snowy-white on the prosternum and sternal side-pieces, slightly darker on the abdomen. The dark brownish hairs form rather moderate-sized maculae which are usually rather obsolete toward base but otherwise arranged as follows: An occasional small humeral and parascutellar macula; post-basal small at middle of each elytron, or obsolete; submedian fascia obsolete or very narrow and zigzag, or broken into two short oblique dots on elytron; subapical transverse row of four maculae which are usually subequal and discrete; apical maculae small or obsolete. Pronotal maculae obscure, discernible as faint clouds, the central one at times appears somewhat oblong.

*Head* about as long as wide, eyes large and moderately strongly convex; front broadly and rather deeply impressed between the antennae and anterior canthi of the eyes, feebly convex toward vertex; surface rather finely and densely indentato-punctate, punctures coarser on the vertex with intervals rugulose; muzzle short and relatively small; hairs at sides of the front and before the eyes rather dense and white. *Antennae* similar in the sexes, moderately long and attaining the pronotal base, rather slender and moderately compressed, apical three joints slightly thickened; second joint oval, slightly longer than wide; third feebly obconical—nearly cylindrical, subequal in length to the fourth, the latter obconico-triangular, apical margin slightly oblique,

feebly prominent anteriorly at the apical angle; fifth as wide as the tenth, triangular, slightly elongate, prominent anteriorly, apical margin feebly oblique; sixth to the eighth subequal in width, sixth and eighth about equal in length, sixth subtriangular and as long as wide; seventh a little longer than wide, subtriangular; eighth about as long as wide, less triangular; ninth about as wide as long, sides feebly arcuate; tenth a little broader, about as long as wide, sides more arcuate, with the ninth and eleventh more circular in transverse section; eleventh about a half longer than wide, obovate; pubescence short and very inconspicuous. The seventh joint tends to be slightly wider than the sixth or eighth.

*Pronotum* about a third wider than long, quite evenly convex, slightly more declivous antero-laterally; apex feebly arcuate in circular arc; sides broadly arcuate, more strongly so behind the middle, less so and moderately convergent anteriorly to apex, serrules small and inconspicuous; fimbriae moderately short, cinereous and rather close; apical angles obtusely rounded; base broadly arcuate and rather feebly sinuate within the very obtuse basal angles, which are as a rule rather broadly rounded; disk widest just behind the middle, rather coarsely and densely indentato-punctate.

*Elytra* oblong, twice as long as wide, sides parallel; disk rather closely and regularly punctate, punctures separated by a distance equal to their diameter, finer and sparser apically; surface very finely microscopically rugulose; apex parabolically rounded.

*Abdomen* densely and finely punctate, pubescence abundant and hiding the body surface; fifth ventral segment modified on the disk in the male.

*Legs* moderate in length; metafemora not swollen, subparallel.

*Male.*—Slightly more parallel. Fifth ventral segment distinctly sinuate, bottom of the sinus transverse, angles obtuse and hidden by the pubescence; adjacent surface impressed and somewhat shining, subglabrous, hairs of the impressed area and terminal segment brownish black, longer and not noticeably bristling, pubescence beyond impressed area normal. Abdomen but very slightly longer than a femur.

*Female.*—Slightly stouter, sides of the body rather more arcuate. Abdomen about twice as long as a femur; fifth ventral rather strongly rounded at apex and less broadly so than in some of the other species.

*Measurements.*—Length (Types), 3.5–4.0 mm.; width, 1.2–1.4 mm.

Holotype, male, in my own collection; allotype, female, in the collection of the California Academy of Sciences; paratypes in both collections.

*Type locality.*—Hullville, Gravelly Valley, Lake County, California. Collected by myself on June 18, 1917. Found abundantly on the catkins of the willow.

*Salicis* appears distinct by its dull lustre, sparse maculation, even and rather dense pubescence and even, close elytral punctuation. Closely related to *niveicanthus* which has a more pronounced maculation. Sometimes *salicis* is almost unicolorous from diminution of the maculae.

*Listrus niveicanthus*, new species.—*Form* oblong-oval, slightly robust and moderately convex. *Color* black, with a feeble aeneous tinge anteriorly; mouth-parts pale; antennae and tarsi rufous; tibiae toward apex more or less rufous. First antennal joint black as usual.

*Pubescence* moderately short, rather fine, recumbent, somewhat sparse and plumbeo-cinereous in color; a tuft of dense snowy-white hairs at anterior canthus of each eye. The areas of dark brown hairs are arranged as follows: Basal maculae more or less obsolete or small when present, the humeral frequently absent when a parascutellar is present on each elytron; post-basal macula not large but variable in size, tending to extend toward the humeral; submedian very narrow and zig-zag, often interrupted at suture and middle of each elytron; subapical usually interrupted forming a transverse row of four maculae, sometimes nearly entire or the sutural two may coalesce to form a small rhomboidal macula on the suture; apical maculae obsolete or small and somewhat transverse. Pronotal central figure usually dissolved into four maculae, two anterior and two posterior, which with those from the broken lateral vittae, make a circle of six small maculae; in some instances the constricted figure appears. The pubescence is longer on the under surface of the body, snowy-white and dense on the prosternum and sternal side-pieces, duller in color on the abdomen and not quite as dense.

*Head* somewhat transverse, distinctly wider than the pronotal apex, eyes moderately large and prominent; front broadly impressed, a small and somewhat glabrous convexity just behind the base of the epistoma; surface densely indentato-punctate. *Antennae* moderate in length and nearly similar in the sexes, moderately compressed; second joint oval, a little longer than wide; third equal in length to the second, obconico-cylindrical in form, a little less than twice as long as wide; fourth and fifth noticeably compressed, fourth slightly elongate and triangular, moderately prominent anteriorly, apical margin oblique; fifth about as wide as the ninth, distinctly wider than the joints between the first and ninth, slightly elongate, about a half longer than wide, angulate anteriorly, apical margin oblique; sixth, seventh and eighth triangular, subequal in length, just a little longer than wide and slightly angulate anteriorly; ninth and tenth triangular, anterior margins moderately arcuate, subequal in width with the eleventh, the latter less than a half longer than wide, oval, slightly narrower at apex.

*Pronotum* transverse, about a fourth wider than long, almost evenly convex; apex broadly arcuate; sides broadly and moderately strongly arcuate, widest a little behind the middle, arcuately convergent anteriorly, angles broadly rounded, the basal sometimes slightly obtuse; base broadly arcuate, feebly sinuate laterally within the angles when obtuse; disk dull in lustre and densely indentato-punctate.

*Elytra* oblong, about twice as long as wide; apex rather parabolically rounded; not deeply punctate, punctures separated by a distance equal to one or two times their diameter, surface more or less transversely and feebly rugose, punctures finer toward apex.

*Abdomen* finely and very densely granulato-punctate; pubescence almost hiding the body surface; fifth ventral segment modified on the disk in the male.

*Legs* moderate in length and stoutness; metafemora rather strongly arcuate dorsally in basal third, rather stout and subparallel, i. e., less narrowed at base.

*Male.*—Slightly narrower, subparallel, antennae slightly heavier; fifth ventral segment distinctly sinuate, adjacent surface impressed and asperate, impressed area invested with black hairs which are not noticeably bristling, pubescence unmodified beyond margin of the impression, sometimes brownish, especially on the genital segment, tactile hairs rather long and somewhat numerous.

*Female.*—Slightly broader, a little more ovate; antennae a little more slender, anterior margin rather less serrate. Metafemora rather more parallel; fifth ventral broadly rounded at apex.

*Measurements.*—Length (Types), 3.2 mm.; width, 1.2–1.3 mm.

Holotype, male, in my own collection; allotype, female, in that of the California Academy of Sciences; paratypes in both collections.

*Type locality.*—Bartlett Springs, Lake County, California. Collected in June by Dr. A. Fenyes.

*Distribution.*—Besides the typical phase taken at Bartlett Springs, I have eight specimens from Pasadena, in Southern California. These are smaller with the apical joints of the antennae somewhat darker, and the central pronotal constricted macula is represented by a rounded macula corresponding to the basal lobe of the "hourglass" spot. In the males the impressed area of the fifth ventral is quite glabrous and the pubescence is longer at the angles. In some *Listri* there is an apparent sixth segment, but it is exceedingly difficult to determine the true structure in dried specimens, especially when they are few in number. Careful dissection is necessary.

From reading Casey's description of *Listrus tritus* Casey, one would refer *nivicanthus* to that species as regards maculation. In *tritus* the

fifth ventral segment in the male is truncate at apex and unmodified on the disk; in *fidelis* Casey it is likewise truncate and unmodified, the pubescence being of the usual character. *Extricatus* Casey is recognized and properly placed from material taken at San Diego and Pasadena, in this species the antennae are stouter and incrassate, and blackish in color, except the second joint which is rufous or testaceous. The above variant of *nivicanthus* taken at Pasadena may be known as *tincticornis*, new subspecies.

*Listrus elegantulus*, new species.—*Form* oblong-oval to oblong-ovate, rather strongly convex. *Color* black, a feeble purpureo-aeneous lustre, especially on the head and pronotum; mouth pale, second joint of the antennae rufo-testaceous, succeeding joints more or less rufo-piceous, apical joints usually blackish; tibiae dark rufo-piceous, tarsi more or less rufous.

*Pubescence* moderately long, abundant and cinereous in color; dark areas of dark brownish hairs arranged as follows: Elytral maculation conspicuous, basal fascia rather broad, usually narrowly interrupted at middle by the albescent scutellum; post-basal macula small at middle of each elytron; median fascia quite broad, edges irregular, extending somewhat along the suture anteriorly; subapical fascia narrower, with edges zig-zag, widening more or less on the suture to form a subrhomboidal figure, and constricted at middle of each elytron almost to the point of division; apical maculae rather large, but variable as to size. Pronotal central macula usually distinctly constricted at middle, basal lobe rather larger than the apical, reëntering lines not evident; lateral vittae more or less obsolete or divided at middle. Central area of the head with darkish hairs.

*Head* somewhat transverse and wider than the pronotal apex, eyes large and prominent; front more or less broadly impressed, at times apparently bi-impressed, a feeble median convexity behind the epistomal base; surface densely indentato-punctate; sometimes the intervals are smooth on the vertex and adjacent front where the punctures are rather coarse, but anteriorly between the antennae they are more densely placed. *Antennae* rather long and slender, feebly compressed toward base, apical joints feebly incrassate; second joint longer than wide and rather obconical; third rather slender and cylindrical, about as long as the fourth or second; fourth more evidently compressed, obconico-subtriangular, slightly prominent anteriorly toward apex; fifth slightly elongate, subtriangular, apical margin rather oblique, anterior border angulate, distinctly wider than the fourth or third, about equal in width to the eighth; sixth and seventh just a little narrower, less noticeably compressed, subtriangular and very slightly longer than wide; eighth triangular in outline

and not noticeably compressed; ninth distinctly wider than long and with the tenth and eleventh just a little wider than the fifth; tenth a little longer than the ninth, subtriangular; eleventh not more than twice as long as wide, nearly an elongate oval.

*Pronotum* about a fourth wider than long, evenly convex, more declivous antero-laterally; apex arcuato-truncate in circular arc; sides broadly arcuate, less so anteriorly and moderately convergent to apex, serrules short and more or less acute, fimbriae rather short and not closely placed; angles broadly rounded, the anterior less so; base broadly and rather evenly arcuate, scarcely sinuate laterally within the angles; disk in the central area rather sparsely punctured, punctures less than coarse, not very sharply defined although deep, intervals rather irregular in width and from two to four times wider than the punctures, not noticeably indented, lateral thirds distinctly and moderately coarsely and densely indentato-punctate.

*Elytra* somewhat oblong-oval, sides moderately arcuate although subparallel, about twice as long as wide; discal punctures not coarse, separated by a distance equal to one or three times their diameter, finer toward apex and more widely spaced, surface feebly transversely rugose.

*Abdomen* finely and rather densely punctate; fifth ventral segment modified on the disk in the male.

*Legs* moderate in length and stoutness; tarsi of medium length.

*Male.*—Oblong-oval, subparallel, somewhat robust as compared to the male of *bifasciatus.* Antennae just a little stouter than in the female. Fifth ventral segment distinctly emarginate, emargination arcuate and moderately deep, lateral angles prominent, impressed surface of the segment subasperate, pubescence longer and blackish to brownish. Metafemora moderately stout and subfusiform.

*Female.*—Oblong-ovate, rather more convex posteriorly, sides a little more arcuate; pronotal sides more strongly arcuate posteriorly. Antennae slightly shorter and a little more slender; fifth ventral rather broadly rounded at apex; abdominal apex with blackish pubescence.

*Measurements.*—Length (Types), 3–3.3 mm.; width, 1–1.2mm.

Holotype, male, allotype, female, in my own collection; paratypes in that of the California Academy of Sciences and that of Mr. F. W. Nunenmacher.

*Type locality.*—Willow Creek, Humboldt County, California. Collected by Mr. Nunenmacher on May 20, 1911, and myself on June 13, 1916.

*Distribution.*—California (Humboldt County; Siskiyou County, June 2, 1911; Mokelumne Hill, Calaveras County, April).

This elegant species in its oblong-ovate or oblong-oval form, rather wide elytral fasciae, quite slender antennae which are very nearly similar

in the sexes, and modified fifth ventral in the male and cinereous pubescence, gives a facies notably different from the other species described in the present paper and also those previously described by Col. Casey.

*Elegantulus* is apparently related to *interruptus* Lec. According to Casey, in *interruptus* the dark pubescence of the elytra is arranged in spots, and he distinctly states that the interstitial spaces of the head and pronotum are polished and without reticulation. In *interruptus* the fifth ventral segment in the male is strongly sinuato-truncate at apex, flattened on the disk and clothed with long erect and bristling hairs, which become black in apical half of the segment. In *elegantulus* the hairs are not very bristly, although rather long and brownish to black in color; the apex of the fifth ventral in the male is distinctly emarginate, with the lateral angles quite prominent.

*Interruptus* is distributed from Nebraska to California, where it does not descend the western slope of the Sierras in California, according to Col. Casey.

*Listrus fulvipilosus*, new species.—*Form* subparallel to elongate-oval and convex. *Color* black, with a feeble bluish metallic lustre and rather shining; antennae more or less rufo-piceous; tibiae dark piceous, tarsi rufous to rufo-piceous.

*Pubescence* rather short, sparse and somewhat coarse, for the greater part fulvous in color, varying in some specimens to plumbeo-cinereous. The darker hairs are arranged in an obscure elytral pattern as follows: A small or moderate humeral and a parascutellar macula on each elytron; a post-basal at middle of each; a narrow zig-zag fascia at middle, which may be dissolved into a transverse row of narrow irregular maculae; subapical transverse row of more or less distinct maculae, and one on each elytron at apex. In some specimens the markings are quite distinct when viewed longitudinally from behind. Pronotal central figure indistinct, or evidently constricted at middle with the lobes divided longitudinally by a median line of pale hairs; lateral vittae more or less dissolved into two maculae. Elytral pattern similar to that observed in *nivcicanthus* and its subspecies *tincticornis*. Hairs of the under surface of the body rather long.

*Head* about as wide as long, quite strongly and broadly bi-impressed between the eyes and antennae, impressions separated by a feeble median convexity that is more or less subglabrous toward the epistomal base, the latter more or less transversely rugulose; surface rather coarsely and densely indentato-punctate, slightly strigose against the eyes. *Antennae* rather slender and moderately dissimilar in the sexes, sometimes pale in color and apparently extending to the pronotal base.

*Pronotum* transverse, about a fourth wider than long, widest at basal third; sides broadly arcuate in basal half and less so anteriorly, converging moderately to apex, serrules small and subacute, fimbriae moderate in length; apex broadly arcuato-truncate, angles obtusely and rather broadly rounded; base broadly arcuate in middle six-eighths, sinuate within the angles, the latter subdentate and obtuse; disk moderately arcuate from side to side, more strongly so anteriorly, more or less coarsely indentato-punctate, densely so laterally, less so in the central area where the indentations are rather shallow.

*Elytra* slightly more than twice as long as wide, at base about equal to the width of the pronotum; rather coarsely punctate, punctures separated by a distance equal to one-half to three times their diameter, surface finely and rather obsoletely rugulose; punctures much finer toward apex, the latter subserrulate on the edge, sutural angles obtusely but not strongly rounded.

*Abdomen* finely, rather densely punctate; fifth ventral segment different in the sexes, being modified on the disk in the male.

*Legs* moderate in length and stoutness; metafemora moderate in stoutness with their dorsal outline distinctly arcuate.

*Male.*—Parallel and slightly oblong. *Antennae* with the second joint oval, slightly narrowed at the base, about a third longer than wide, quite equal in length to the third; the latter cylindrical, twice as long as wide, comparatively narrow; fourth obconical, feebly prominent anteriorly, about a half wider than long, subequal in length to the third; fifth rather elongate, subtriangular, about a third longer than the width of the apex, apical margin transverse, as wide as the seventh, distinctly wider than the sixth, fourth, third or second, moderately prominent anteriorly; sixth and eighth triangular, about as long as wide and subequal; seventh almost triangular, longer than wide, sides slightly arcuate; ninth wider, triangular, about as long as wide; tenth subtriangular, less narrowed toward base, sides noticeably arcuate, very slightly longer than wide; eleventh elongate oval, feebly narrowed apically, almost twice as long as wide. Fifth ventral segment modified; broadly and rather deeply emarginate, emargination rounded, adjacent surface of the segment rather glabrous and shining, the impressed area semilunar in outline, surface beyond subasperate, set with rather long but not dense blackish hairs which extend somewhat on to the apex of the fourth segment; hairs rather long at the angles of the emargination, the latter rather obtuse. Modified area blackish.

*Female.*—Subparallel, sides of the body slightly arcuate. *Antennae* more slender, joints proportioned as in the male; the fourth rather subtriangular; fifth slightly narrower, less prominent anteriorly, apical

margin rather oblique, obtusely angulate anteriorly; tenth noticeably less stout, about as long as wide, quite triangular; eleventh obovate, shorter, about a half longer than wide. Fifth ventral broadly and evenly arcuate at apex, somewhat broadly flattened, margin slightly deflexed.

*Measurements.*—Length (Types), 3.0–3.5 mm.; width, 1.1–1.3 mm.

Holotype, male, and allotype, female, in my own collection; paratypes in that of Mr. F. W. Nunenmacher, who collected the material on June 4, 1913.

*Type locality.*—Lassen County, California.

Twenty specimens studied. *Fulvipilosus* resembles *amplicollis* Casey, from which it differs in the densely punctured pronotum, male sexual characters and more or less fulvous pubescence.

*Listrus cervicalis*, new species.—*Form* oblong-oval and moderately convex. *Color* black, with a slight aeneous lustre, chiefly on the head and pronotum; antennae more or less piceous, second joint rufo-piceous; tibiae and tarsi piceous.

*Pubescence* moderate in length, abundant and plumbeo-cinereous in color, longer on the under surface of the body, cinereous on the sterna and sternal side-pieces, slightly darker on the abdomen. Brownish black hairs of the elytra are arranged in rather large maculae as follows: A narrow and elongate humeral and a rounded parascutellar macula; post-basal macula at middle of each with a tendency to diffuse toward the humeral; a submedian rather wide and more or less zig-zag fascia which may or may not be interrupted at the suture or at middle of each elytron; subapical transverse row of four rather large maculae; apical maculae of good size. There is a tendency for the maculae to coalesce transversely to form five transverse dark fasciae. Pronotal central figure constricted and more or less divided by a narrow median line of pale hairs into four maculae, lateral vittae broken into two distinct maculae; hairs of the central area of the frons more or less dark. Hairs of the pronotum are rather stiff, closely recumbent and somewhat abundant.

*Head* rather large, about as long as wide, eyes moderately prominent and evenly convex. Front broadly impressed, a slight median convexity near the epistomal base, punctures moderate in size and rather sparse, denser at the periphery, intervals more or less smooth and more or less feebly punctulate or subindentate; muzzle short and rather broad, margin evenly arcuate from side to side. *Antennae* quite long, somewhat slender, and only slightly compressed, feebly incrassate and similar in the sexes; second joint oval narrowing somewhat toward base; third cylindro-obconical and as long as the fourth, the latter wider and triangulo-obconical; fifth wider, about as wide as the ninth, triangular and just a little longer than wide, quite prominent anteriorly; sixth to the eighth

subequal in length and size, subtriangular, almost circular in transverse section; ninth and tenth stouter, a little longer, subtriangular and circular in section; eleventh obovate, rather stout, about a half longer than wide.

*Pronotum* about a fourth wider than long, slightly transversely oblong; apex wide, moderately broadly arcuate in circular arc; apical angles rather obtusely rounded; sides quite broadly arcuate, converging very moderately anteriorly, more or less feebly sinuate before the basal angles (see sexes), serrules moderate in size and rather irregular, fimbriae moderate in length; base broadly and rather strongly arcuate, feebly sinuate laterally, angles apparently rounded although subobtuse from a rather broad and reflexed denticle; disk quite strongly convex, rather strongly declivous antero-laterally, punctures rather large, somewhat widely spaced in the central area, intervals flat, more or less indentated toward base, densely indentato-reticulato-punctate laterally.

*Elytra* scarcely twice as long as wide, oblong, apex rather broadly and evenly rounded; sides parallel and slightly arcuate; punctures rather coarse, separated by a distance equal to two or three times their diameter; surface smooth, punctures finer toward apex.

*Abdomen* finely and more or less densely ruguloso-punctulate; fifth ventral segment modified on the disk in the male.

*Legs* moderately stout and a little longer than usual.

*Male.*—Slightly narrower and a little more parallel. Pronotal sides rather less arcuate, as a rule slightly sinuate before the basal angles, serrules a little coarser, basal angles more obtuse. Fifth ventral broadly and somewhat deeply sinuate, lateral angles rather prominent and narrowly rounded, adjacent surface distinctly impressed and more or less glabrous, margin of impression asperate and set with rather stout black hairs which may extend forward on to the fourth segment for a short distance; terminal segment of the abdomen set with shorter black hairs.

*Female.*—A little broader and more arcuate at the sides. Pronotal sides, as a rule more arcuate, scarcely sinuate before the basal angles, the latter more broadly rounded. Fifth ventral not very broad at apex, sides converging more strongly, tip not very strongly rounded, margin narrowly deflexed and asperate, surface of the segment feebly impressed.

*Measurements.*—Length (Types), 3.3–3.5 mm.; width, 1.2–1.3 mm.

Holotype, male, and allotype, female, both in the collection of the California Academy of Sciences; paratypes in the Academy's and my own collection.

*Type locality.*—Huntington Lake, Fresno County, California, at an elevation of 7000 feet. Beaten from fir trees. A large series were secured by Mr. E. P. Van Duzee and myself during July, 1919.

*Cervicalis* at first sight resembles *montanus* Casey; in the former the maculation is more distinct, pronotum broader and more convex and the fifth ventral segment is modified in the male, besides there is a tendency for the elytral maculae to unite to form five transverse dark fasciae, which are frequently in evidence and unique.

## SYNOPSIS OF THE SPECIES OF LISTRUS.

The species of Listrus may be divided into two Sections as follows:

Fifth ventral abdominal segment in the male, truncate or sinuato-truncate at apex.....Section I

Fifth ventral more deeply sinuate and modified on the disk in the male.....Section II

The species can be arranged in the following Groups:

### Section I.

Elytral apices different in the sexes.....Definitus Group

Elytral apices similar in the sexes..... 1

1. Eyes very prominent and more strongly convex in anterior two-thirds; head broad, male.....Cephalicus Group

—. Eyes moderately prominent and evenly convex..... 2

2. Elytral pubescence unicolorous.....Senilis Group

—. Elytra ornate with a pattern of blackish or brownish-black hairs..... 3

3. Elytral pubescence very short, pattern very obscure from sparseness of pale hairs.....Punctatus Group

—. Elytral pubescence longer and more abundant, pattern distinct..... 4

4. Elytra with three rather wide transverse black fasciae, the basal of which may be more or less interrupted.....Annulatus Group

—. Elytral fasciae more or less modified or broken up..... 5

5. Species with legs more or less piceous or rufo-piceous, femora never pale.....Difficilis Group

—. Species usually scarcely over 2.5 mm. in length, except *luteipes* (3 mm.); legs entirely pale; basal and post-basal fasciae broken up into variable small maculae.....Luteipes Group

### Section II.

Metatrochanters triangular.....Trochantericus Group

Metatrochanters of the usual form, suboval..... 1

1. Pubescence short and sparse, elytral pattern obscure but discernible..... Liebecki Group

—. Pubescence longer, elytral pattern distinct..... 2

2. Elytral maculation tending to form fasciae and nearly constant in character..... Interruptus Group

—. Elytral maculation consisting of isolated maculae tending to obsolescence..... Salicis Group

#### DEFINITUS GROUP.

Elytra with a wide subapical black fascia; apices acuminately produced in the female and rounded as usual in the male; pronotum longer than wide; legs entirely pale..... 1. *definitus* Fall

CEPHALICUS GROUP.

Head broad, eyes very prominent and strongly convex anteriorly, forming a straight and posteriorly convergent line with the temporal region; elytral maculation obscure; legs and antennae stout..... 2. *cephalicus*, n. sp.

SENILIS GROUP.

Body densely and uniformly clothed with coarse and dense cinereous hairs..... 3. *senilis* Lec.

Body more sparsely clothed with finer and less cinereous pubescence..... 1

1. Tenth antennal joint almost as long as wide; male elongate and parallel; antennae distinctly longer than the pronotum..... 4. *uniformis* Casey

—. Tenth antennal joint transverse..... 2

2. Fifth ventral abdominal segment truncate at apex, male; pronotal disk broadly, evenly convex..... 5. *clavicornis* Casey

—. Fifth ventral longer, arcuato-truncate at apex, male; pronotal disk arcuately declivous antero-laterally..... 6. *coloradensis*, n. sp.

PUNCTATUS GROUP.

Basal angles of the pronotum distinctly obtuse and angulate; sixth and eighth antennal joints distinctly smaller than the contiguous joints..... 7. *obscurellus* Lec.

Basal angles of pronotum broadly rounded and quite continuously so with the sides and base..... 1

1. Smaller species and not elongate; antennae subclavate, joints four to eight scarcely longer than wide; frons and central area of pronotum sparsely and distinctly punctate; fimbriae very short..... 8. *punctatus* Motsch.

—. Larger species; antennae not clavate, long and slender, joints distinctly elongate; pronotum more transverse; fimbriae moderate in length; pubescence longer; elytral pattern discernible..... 9. *dilutus*, n. sp.

ANNULATUS GROUP.

Elytra with three transverse fasciae, the median widest, tending to diffuse along the suture; head and pronotum noticeably narrower than the elytral base; central area of pronotum very sparsely punctate.....10. *martini*, n. sp.

Elytra with three almost even transverse dark fasciae; surface somewhat dull; fourth and fifth antennal joints triangular..... 1

1. Legs piceous or black; form stouter and oblong (male), or oblong-ovate (female) .....11. *annulatus* Casey

—. Legs rufous; form feebly elongate, oblong-oval.....12. *rubripes* Casey

DIFFICILIS GROUP.

Pronotum strongly and closely indentato-punctate in the central area..... 1

Pronotum not closely punctate in the central area but with the intervals flat and more or less smooth..... 7

1. Third antennal joint in the male with a moderately stout chitinous seta near the antero-apical angle; male parallel and elongate, antennae heavy; female elongate ovate, antennae moderately slender.....13. *maculosus* Casey

—. Third antennal joint in the male without a stouter seta..... 2

2. Third antennal joint elongately triangular; elytral maculae more or less rounded .....14. *montanus* Casey

—. Third antennal joint more or less cylindrical..... 3

3. Dark elytral maculae small and few in number, pubescence otherwise cinereous ..... 15. *confusus* Casey
—. Dark elytral maculae well developed ..... 4
4. Tibiae and tarsi clear rufous; lustre more or less cupreous; antennae similar in the sexes, fifth joint scarcely wider than the contiguous joints ..... 16. *extricatus* Casey
—. Tibiae and tarsi more obscure, black to rufo-piceous in color ..... 5
5. Elytra with submedian and subapical fasciae ..... 17. *difficilis* Lec.
—. Elytra without two distinct fasciae ..... 6
6. Elytral subapical fascia alone distinct; submedian resolved into two strongly V-shaped maculae; pubescence dense and very coarse ..... 18. *fidelis* Casey
—. Elytral dark areas in large maculae; pubescence rather short, sparse and readily removable ..... 19. *subaeneus* Casey
7. Tarsi and distal part of tibiae rufous ..... 8
—. Tarsi and tibiae more or less piceous ..... 9
8. Submedian elytral fascia zig-zag, narrow, V-shaped on each elytron; subapical forming a moderate rhomboidal macula on the suture, apical maculae rather large; tarsi and tibiae rufous ..... 20. *vestitus*, n. sp.
—. Submedian and subapical fasciae transverse, the latter rather broad; tarsi and distal half of tibiae rufous or paler ..... 21. *incertus* Casey
9. Size larger. Pubescence noticeably long; elytral maculation complex, subapical fasciae broken into four rather large maculae, the two median of which may form a subcordate macula on the suture ..... 10
—. Size smaller; elytral pattern simpler ..... 12
10. Form different in the sexes; male rather narrow, parallel and elongate; female oblong-ovate; second antennal joint a half longer than wide, third obconic, fourth distinctly triangular; pubescence quite abundant on abdominal apex ..... 22. *bifasciatus*, n. sp.
—. Form somewhat similar in the sexes; male oblong-oval; female oblong-ovate; antennae similar in the sexes; third and fourth antennal joints elongate and subequal in length ..... 11
11. Fifth antennal joint distinctly longer than wide at apex. Surface with a purplish metallic reflection; fifth ventral segment broadly truncate at apex; pale elytral fasciae narrow and distinctly zig-zag ..... 23. *pardalis* Casey
—. Fifth antennal joint about as long as wide at apex. Surface with a bluish-metallic reflection; fifth ventral broadly and feebly sinuato-truncate; pale elytral areas broader about the more or less round maculae ..... 24. *motschulskii* Lec.
12. Elytra distinctly fasciate with dark hairs ..... 13
—. Elytra not fasciate, but with discrete maculae that are more or less atrophic ..... 16
13. Upper surface of body shining and polished; surface with a greenish- or bluish-metallic lustre ..... 14
—. Upper surface more or less dull and with a cupreous or violaceous lustre ..... 15
14. Elytra with three distinct and rather broad transverse fasciae, the basal narrowly interrupted at scutellum, post-basal maculae obsolete; pronotum quite strongly convex ..... 25. *simplex*, n. sp.
—. Elytra without three fasciae; pubescence short, sparse, maculation rather obscure; punctures at middle of pronotum sparse, intervals more or less punctulato-rugulose ..... 26. *interstitialis* Casey

15. Surface lustre above cupreous throughout; pubescence rather short, maculation less distinct; antennae rather slender basally, last three joints stouter and feebly incrassate.....27. *variegatus* Casey
—. Surface lustre cupreous on head and pronotum, violaceous or darker on elytra; pubescence longer, maculation distinct, antennae somewhat stouter .....28. *incestus*, n. sp.
16. Surface lustre slightly brassy; pubescence rather long, coarse and cinereous, except for a few dark maculae behind middle of the elytra, of which four are arranged in a subapical transverse row.....29. *tritus* Casey

LUTEIPES GROUP.

Antennal joints (male) from the third to the ninth distinctly elongate; pubescence rather short and cinereous; median and subapical fasciae well defined and moderately narrow; legs entirely pale.....30. *giffardi*, n. sp.
Antennal joints not elongate; elytral pubescence unevenly distributed toward base ..... 1
1. Head and thorax noticeably small, distinctly narrower than the elytral base; elytral dark fasciae more or less diffused; legs pale.....31. *parvicollis*, n. sp.
—. Head larger, pronotum about as wide as the elytral base..... 2
2. Pronotum longer, central area rather sparsely and distinctly punctate, intervals more or less smooth; fourth antennal joint obconico-triangular; legs pale.....32. *luteipes* Lec.
—. Pronotum shorter, transverse, densely indentato-punctate..... 3
3. Albo-cinereous hairs of the elytra elongate-lanceolate and somewhat squamiform, very dense in a narrow transverse fascia at apical third; fourth antennal joint triangular; legs bright rufous.....33. *famelicus* Casey
—. Cinereous hairs of the elytra slender as usual..... 4
4. Legs piceous; elytral pubescence unevenly distributed anterior to a moderately wide subapical dark fascia; fourth antennal joint obconical.....34. *ornatulus* Casey
—. Legs rufous ..... 5
5. Smaller species (1.9 mm.); fourth antennal joint feebly triangular; basal joint pale; elytra with a dark wide median and a narrower subapical fascia, and two rounded maculae on each toward base....35. *concurrens* Casey
—. Larger species (1.9–2.3 mm.); fourth antennal joint triangular (male), or obconical (female); elytra with an even transverse subapical fascia, apex with a few scattered dark hairs, and feeble trace of small brownish maculae toward base.....36. *balteellus* Casey

TROCHANTERICUS GROUP.

Pubescence coarse, cinereous, rather dense; form feebly elongate; median elytral fasciae narrow, zig-zag or broken up; pronotal central area closely indentato-punctate. Antennae moderate in length, slightly compressed; third joint cylindrical; fourth obconico-triangular; sixth, seventh and eighth subequal in size and length; fifth serrate as usual in the male .....37. *trochantericus*, n. sp.

LIEBECKI GROUP.

Antennae long and rather stout; joints three, four and five elongate; fourth quite triangular; third rather slender, slightly more than twice as long as wide (male).....38. *liebecki*, n. sp.

Antennae notably stout; joints sixth to the ninth subequal in size and form; fourth distinctly triangular and scarcely longer than wide; third rather short, not twice as long as wide (male). More slender and subclavate in the female.....39. *olympianus*, n. sp.

SALICIS GROUP.

Central area of the pronotum not indentato-punctate, intervals flat; smaller species, lustre aeneous; antennae and legs clear rufous; antennal joints six to nine not elongate.....40. *occidens*, n. sp.

Central area of the pronotum densely indentato-punctate..... 1

1. Antennae moderately stout and blackish in color; lustre dark, maculation well developed; fourth antennal joint triangular; fifth joint serrate and about as wide as the ninth (male); pubescence of the fifth ventral segment scarcely modified in the male; antennae moderately dissimilar in the sexes.....41. *angulatus*, n. sp.

—. Antennae rufous or rufo-piceous in color, lustre more or less aeneous; tibiae and tarsi more or less rufo-piceous..... 2

2. Fourth antennal joint obconico-triangular; fifth joint scarcely wider than the sixth; joints three to nine moderately elongate in the male; antennae moderately dissimilar in the sexes.....42. *salicis*, n. sp.

—. Fourth antennal joint not strongly triangular; joints three, four and five elongate, six, seven and eight less so; fifth not strongly serrate; antennae more slender in the female.....43. *niveicanthus*, n. sp.

Form smaller, apical joints of antennae darker.....*tincticornis* n. subsp.

INTERRUPTUS GROUP.

Interstitial spaces of the central area of the pronotal disk, flat and smooth; spaces variable in width..... 1

Interstitial spaces more or less indentate; surface more or less densely indentato-punctate ..... 5

1. Pubescence short, very sparse; maculation scarcely discernible; antennae slender, more or less rufo-piceous, fifth joint scarcely wider than the following two or three joints.....44. *amplicollis* Casey

—. Pubescence longer and denser; maculation distinct..... 2

2. Lustre more or less aeneous; pubescence moderately long; antennae rufo-piceous ..... 3

—. Lustre dark, bluish or greenish metallic; pubescence shorter..... 4

3. Maculation consisting of rounded maculae on the elytra; fifth ventral of the male broadly and strongly sinuato-truncate at apex, flattened on the disk and clothed with long erect and bristling hairs which become black in apical half.....45. *interruptus* Lec.

—. Maculation consisting of three moderately wide fasciae, median and subapical with irregular edges; fifth ventral clothed with brownish gray hairs on the flattened area.....46. *elegantulus*, n. sp.

4. Lustre with a dark steel-blue metallic reflection; legs and antennae black throughout; pubescence very short, decumbent and coarse, a median and subapical fascia with basal, post-basal and apical maculae, or with fasciae broken into maculae.....47. *rotundicollis* Casey

—. Lustre with a virido-aeneous reflection; legs and antennae more or less picescent, second joint paler; pubescence rather short, dark areas large, two wide and straight transverse fasciae on the elytra behind the

middle .....48. *canescens* Mann.

5. Antennae rufo-testaceous, tibiae rufo-piceous, tarsi rufous; antennae moderately long, joints three, four and five rather elongate, sixth triangular and about as wide as the fifth.....49 *fulvipilosus*, n. sp.

—. Antennae, tibiae and tarsi dark piceous; antennae long, heavy, last two joints particularly stout; sixth, seventh and eighth feebly incrassate, about equal in length and size; maculation tending to form five transverse fasciae on elytra, the basal two of which are usually broken..... .....50. *cervicalis*, n. sp.

The following two species have not been recognized with certainty in the material that has passed through my hands. Both species were founded on females. The following descriptive outlines have been epitomized from Casey:

51. *Listrus plenus* Casey.—*Form* elongate-oval, strongly convex. *Color* polished black, without metallic lustre; second joint of the antennae piceous. Pubescence short, sparse, feebly persistent and with large dark areas on the elytra.

*Head* sparsely perforato-punctate, the interspaces flat and somewhat rugose. Antennae slender, quite distinctly longer than the pronotum, the tenth joint about as long as wide.

*Pronotum* two-fifths wider than long; sides evenly and moderately convergent and feebly arcuate from near the base to the obtuse and somewhat rounded apical angles; apex broadly arcuato-truncate and wider than the pedunculiform part of the base, which is more pronounced than usual; disk widest at basal third, moderately coarsely, deeply and very closely perforato-punctate, scabrous and opaque in lateral fourth; punctures separated by barely their own dimensions, the narrow interspaces sparsely and feebly punctulate. *Elytra* three-fourths longer than wide, fully one-third wider than the pronotum, parallel, acutely parabolic in apical third, coarsely and rather sparsely punctate, more finely so toward apex as usual.

Length, 3.0 mm.; width, 1.2 mm.

*Type locality.*—Vancouver Island.

52. *Listrus densicollis* Casey.—*Form* stout, oblong-oval, somewhat depressed above. *Color* black with a greenish-brassy lustre. Pubescence short, sparse, cinereous, not very persistent, with large indefinite dark patches on the elytra.

*Head* densely punctate, interspaces feebly rugose; frontal impressions distinct. Antennae only very little longer than the pronotum, tenth joint one-half wider than long.

*Pronotum* one-half wider than long, widest at basal third, where the sides are rather broadly and evenly rounded, thence strongly convergent

and feebly arcuate to the apex, the latter truncate and scarcely narrower than the pedunculate base; apical angles very obtusely rounded; lateral serrules strong; disk somewhat finely but deeply and closely perforato-punctate, the intervals flat and feebly, sparsely punctulate, only slightly wider than the punctures; rugose area in lateral fourth.

*Elytra* oblong, two-thirds longer than wide, fully one-third wider than the pronotum, parallel, parabolic in apical third; humeri tumid and prominent; punctures rather coarse, deep and sparse.

Length, 3.2–3.8 mm.; width, 1.2–1.4 mm.

*Type locality.*—Napa County, California.

In the Leng Catalogue of the Coleoptera of North America recently issued, Motschulsky's *Listrus tibialis* has been given a regular place in the arrangement of species. Casey was unable to identify it when he wrote his revision of the genus *Listrus* Mots. in 1895. I have likewise failed to recognize it up to the present time. Inasmuch as I have mentioned two of Casey's species that I could not identify, it will be quite proper at the present time to give the translation of Motschulsky's description, which is as follows:

53. *Listrus tibialis* Mots.—*Form* elongate-subovate, rather convex and shining; punctate and sparsely clothed with cinereous pubescence. *Color* nigro-aeneous above, black beneath; tibiae rufo-testaceous, labrum and tarsi infuscate; antennae and femora blackish.

*Head* between the eyes transversely carinulate, carinula strongly shining.

*Pronotum* transverse, narrowed anteriorly; apical angles distinct, the posterior angles rounded; sides subcrenulate and set with rather long fimbriae.

*Elytra* subovate and arcuately narrowed posteriorly; clothed with cinereous pubescence.

*Measurements.*—Length, 1⅙ 1.; width, ⅓ 1.

*Habitat.*—Ross (Sonoma County, California).

It is hoped that the synoptical arrangement as given above will aid the student in placing the several species of these pretty little melyrids. There will be disappointment in its application, as there are yet many species to be discovered, and these undescribed forms will unwittingly be intermixed and referred to some of the species already named. The selected characters are not as complete as I wish they were, for a considerable per cent of the specimens studied were mounted in such a way that it was impossible to see the antennae, metatrochanters or fifth ventral abdominal segment. An attempt was made to remount some of the specimens, but they proved too fragile and could not be properly manipulated without destruction. So it was decided at the present time not to

delay making known the species that have already in part been distributed under manuscript names.

Before closing this thesis it will be well to urge the student to familiarize himself with the pronotal sculpturing, to determine that it consists of distinct and well defined punctures and that the intervals may be more or less distinctly indented after the manner of hammered brass. The basal joint of the antennae is always black, with one exception, and that is in *concurrens* Casey.

## Genus **DASYTES** Payk.

*Dasytes nevadensis*, new species.—*Form* subcuneiform, elongate. *Color* polished black, with a very faint greenish metallic lustre; tibiae and tarsi scarcely or feebly nigro-piceous.

*Pubescence* nigro-fuscous, sparse, moderate in length, rather coarse, semierect, very irregularly directed on the head and pronotum; marginal cilia widely spaced and not noticeably fimbriform.

*Head* rather large, wider across the eyes than the pronotal apex; front very broadly and feebly bi-impressed, punctures sparse, rather small; surface shining and somewhat wrinkled along the eyes and frontal margin; muzzle short. Eyes moderately prominent, broadly convex, setigerous, setae short and sparse. *Antennae* rather long, reaching well beyond the pronotal base, joints four to ten inclusive subequal, eleventh about twice as long as wide.

*Pronotum* about a fourth wider than long, widest behind the middle where the sides are distinctly and evenly arcuate, somewhat constricted anteriorly where the sides are rather deeply sinuate behind the apical angles, lateral margins distinctly and rather strongly serrulate; apex broadly and feebly arcuate, rather arcuato-truncate in middle third, narrower than the base; apical angles obtuse and more or less rounded; base broadly arcuate, continuously so with the broadly rounded angles, which are really obtuse and reflexed when viewed obliquely; disk rather strongly convex anteriorly and centrally, less so toward the basal angles, submarginal line very strong and passing arcuately from side to side along the basal margin, central area very sparsely punctate, punctures quite evenly spaced, intervening surface glabrous and shining, lateral area rather narrow and strongly reto-rugose.

*Elytra* about one and a half times longer than wide, widest behind the middle, sides converging anteriorly, apex rather broadly and parabolically rounded; disk moderately convex, punctures rather sparse and not strong, somewhat obscured by the transverse subrugulation.

*Abdomen* densely and rather coarsely punctate, surface distinctly and transversely rugulose.

*Male.*—Somewhat narrow. Fifth ventral segment truncate, adjacent surface rather broadly and lunately impressed; pygidium arcuately emarginate, lateral angles rounded.

*Female.*—Somewhat broader. Fifth ventral arcuately rounded at apex, sometimes the adjacent surface is somewhat flattened.

*Measurements.*—Length, 3.0–3.4 mm.; width, 1.0–1.4 mm.

*Type locality.*—Goldfield, Esmeralda County, Nevada.

Holotype, male, and allotype, female, in my own collection. Collected by Mr. F. W. Nunenmacher, who also possesses paratypes. Obtained by beating.

*Remarks.*—By the heavy submarginal line and the pubescence not being intermingled with longer erect hairs and black legs, it is related to *nitens* Casey. In *nitens* however, the pronotal sides are much more evenly arcuate and not constricted and emarginate behind the apical angles.

*Dasytes angulatus*, new species.—*Form* elongate ovate, wider posteriorly, somewhat depressed. *Color* black, sometimes brownish, moderately shining; mouth parts more or less pale, tibiae and tarsi pale rufous or rufo-piceous.

*Pubescence* brown to grayish-brown, short, decumbent and sparse; pronotal and elytral fimbriae very short and somewhat blackish, on the former somewhat erect, on the latter a little longer and paler at apex.

*Head* about as wide as the pronotal apex; front feebly convex, impressions feeble, rather long and separated by a median and very slight longitudinal convexity; surface finely, sparsely punctate and microscopically reticulate.

*Pronotum* about a fourth wider than long; sides scarcely arcuate, rather broadly sinuate behind the angles, convergent from base to apex as viewed from above, or feebly arcuate at middle, straight and converging anteriorly, converging to base in basal fourth as viewed obliquely from the side; apex rather broadly emarginate; apical angles blunt and subrectangular; base broadly arcuate, distinctly sinuate within the angles, these are subacute and more or less minutely prominent; disk with a distinct submarginal line that is somewhat abbreviated anteriorly and passing arcuately into the basal submarginal groove, surface declivous laterally, feebly impressed before and within the basal angles so that the intervening surface appears oblique and more or less gable-like toward the impressed line at basal fourth; central area very feebly and sparsely punctate, laterally microscopically reticulato-asperate.

*Elytra* about twice as long as the width at base; sides moderately divergent to basal third, thence broadly and evenly arcuate to apex;

margin narrow, not noticeably reflexed; disk very gradually declivous posteriorly, more strongly so laterally, surface very finely and reticulato-rugulose; punctures fine and moderately sparse; humeri not prominent and without umbones.

*Abdomen* very finely punctate.

*Male.*—Fifth ventral segment rather broadly rounded but truncate at middle third of apex; surface rather broadly impressed before the truncature, margin set with short stiff hairs.

*Female.*—Broader. Pronotal sides more broadly arcuate and less convergent toward apex, surface not noticeably impressed in the basal region and more evenly convex, submarginal line less deeply impressed toward base. Fifth ventral broadly rounded.

*Measurements.*—Length (Types), 2.8–3.1 mm.; width, 1.2–1.4 mm.

Holotype, male, and allotype, female, in the collection of the California Academy of Sciences. Paratypes in the Academy's and my own collection.

*Type locality.*—Mt. Eddy, Siskiyou County, California. Collected by Mr. E. P. Van Duzee, on July 28, 1918, at an elevation of 9000 feet.

In many specimens the trochanters and anterior femora are pale dorsally at base. The first joint of the hind tarsi is about equal in length to the third and fourth taken together. *Angulatus* by its distinct basal angles of the pronotum differs from all other species of the genus, its pubescence is uniform over the upper surface, longer, denser and grayer on the abdomen beneath.

*Dasytes shastensis horridulus*, new subspecies.—*Size* comparatively large and quite similar in the sexes. *Form* oblong-oval, about two and a seventh times longer than wide, moderately convex. *Color* black; mouth-parts, antennae, tibiae and tarsi more or less piceous; surface more or less shining, metallic lustre scarcely discernible.

*Pubescence* quite long and abundant, consisting of erect, black, bristling and paler almost recumbent hairs.

*Head* scarcely as wide as the pronotal apex; front quite plane, feebly and broadly impressed; quite coarsely and closely punctate. Muzzle short and broad. Eyes large and moderately convex, distinctly setigerous.

*Antennae* similar in the sexes, rather long and loose-jointed, rather moderately compressed, not incrassate; second and third joints subequal in length, second about a half longer than wide, nearly twice as stout as the third, which is relatively slender and almost twice as long as wide; fourth and fifth joints subequal in length, subtriangular and slightly longer than wide; sixth to the tenth inclusive triangulo-moniliform, about as long as wide; eleventh elongate, subovate and distinctly as long as wide.

*Pronotum* about a fourth wider than long; apex feebly arcuate; apical angles quite broadly and obtusely rounded; sides evenly and moderately strongly arcuate, serrations short and blunt; base broadly and rather strongly arcuate, rounding into the sides without basal angles; disk evenly and moderately strongly arcuate from side to side, punctures moderate in size, evenly placed, separated by a distance equal to their diameter, submarginal line coarse, sometimes more or less broken anteriorly, lateral area reticulato-rugose.

*Elytra* oblong, a little wider posteriorly, sides parallel, very feebly arcuate, apex very broadly rounded; punctures distinctly smaller than on the pronotum, and separated by a distance equal to twice their diameter; base equal to the width of the pronotum.

*Abdomen* finely and rather densely punctate; fifth segment more densely and subasperately sculptured.

*Legs* moderate in length and not stout; metatarsi long and slender, quite equal to the length of their tibia.

*Male.*—Fifth ventral segment broadly and feebly arcuato-truncate.

*Female.*—Fifth ventral broadly rounded at apex.

*Measurements.*—Length (Types), 3.8–4 mm.; width, 1.7–1.8 mm.

Holotype, male, and allotype, female, and one paratype (male) in my own collection.

*Type locality.*—Crystal Lake, San Mateo County, California. Collected by myself on June 27, 1919.

*Distribution.*—Occurs also on Mt. Tamalpais, Marin County, California; captured June 25, 1920.

Quite distinct in its large size, longer and moderately close pubescence, stouter and more elongate second antennal joint; the submarginal pronotal line is coarse and oftentimes much broken up anteriorly. It is undoubtedly closely related to *shastensis* Blais., which when compared with *horridulus*, is smaller in size, pronotum less strongly punctured in the central area, second antennal joint less elongate, less stout and inclined to narrow toward the base.

## SYNOPSIS OF THE SPECIES OF DASYTES PAYK.

Submarginal line of the pronotum feeble, frequently only evident as an abrupt division between the smooth and rugose portions of the surface ..... 1
Submarginal line strong, impressed and usually entire ..... 2
1. Elytra each with longitudinal dark vittiform lines ..... 1. *lineellus* Casey
—. Elytra without vittae ..... 11
2. Pubescence distinctly intermingled with longer, erect black hairs ..... 3
—. Pubescence not intermingled with longer, erect black hairs ..... 8
3. Elytral vestiture blackish throughout ..... 2. *hudsonicus* Lec.

—. Elytral vestiture more or less pale ..... 4
4. Vestiture cinereous but becoming dark and inconspicuous behind the middle of the elytra which are broad and depressed ..... 3. *expansus* Casey
—. Vestiture cinereous with longer, erect black hairs on the elytra ..... 5
5. Basal angles broadly rounded; pale hairs recumbent ..... 6
—. Basal angles obtuse ..... 7
6. Size usually under 3 mm.; pubescence shorter ..... 4. *shastensis* Blais.
—. Size larger, 4 mm.; pubescence longer, form more oblong ..... 5. *horridulus*, n. subsp.
7. Thoracic punctures coarse and impressed; pale hairs suberect.. 6. *vicinus* Blais.
—. Thoracic punctures fine and sparse ..... 7. *obtusus* Casey
8. Legs pale throughout ..... 9
—. Legs bicolored, femora black ..... 10
9. Pronotal margins serrulate and deeply sinuate behind the apical angles, pubescence blackish ..... 8. *nevadensis*, n. sp.
—. Pronotal margins feebly serrulate and feebly sinuate anteriorly; pubescence yellowish ..... 9. *nitens* Casey
10. Elytral pubescence blackish and inconspicuous but becoming ashy toward base; antennae stouter and longer ..... 10. *breviusculus* Casey
—. Elytral pubescence pale cinereous throughout, even but rather sparse; body more elongate; antennae shorter ..... 11. *dissimilis* Casey
11. Elytral vestiture uneven in distribution, brownish-black hairs forming a basal and subapical broad fascia ..... 12. *seminudus* Lec.
—. Elytral vestiture uniform in distribution ..... 12
12. Basal angles of pronotum rounded ..... 13
—. Basal angles more or less distinct ..... 17
13. Legs black or blackish in color throughout ..... 14
—. Legs more or less pale in color ..... 15
14. Pubescence coarse, cinereous, dense, short, recumbent, and uniformly distributed ..... 13. *musculus* Fall
—. Pubescence cinereous, moderately dense, rather short, not very coarse, suberect and intermixed toward sides with a few black setae on pronotum ..... 14. *macer* Casey
15. Legs bicolored, pale rufous, femora black ..... 15. *cruralis* Lec.
—. Legs rufo-ferruginous throughout, femora occasionally slightly darker ..... 16
16. Prothorax much narrower than the base of the elytra ..... 16. *pusillus* Lec.
—. Prothorax equal in width to base of elytra ..... 17. *minutus* Casey
17. Basal angles of pronotum subrectangular and distinct, base sinuate within the angles; legs pale ..... 18. *angulatus* n. sp.
—. Basal angles obtuse ..... 18
18. Legs dark in color; elytral vestiture consisting of shorter and longer hairs which are confusedly intermingled ..... 19. *fastidiosus* Casey
—. Legs entirely pale or bicolored ..... 19
19. Legs bicolored, femora black; erect hairs of elytra extremely short and indistinct, only visible toward apex ..... 20. *depressulus* Casey
—. Legs rufo-testaceous; pubescence luteo-cinereous, rather long, suberect, consisting especially on elytra of somewhat uniformly mixed shorter, more inclined and recurved, longer, and a little less inclined hairs ..... 21. *clementae* Fall

## NOTES ON THE DISTRIBUTION OF THE SPECIES OF DASYTES PAYK.

1. *Dasytes lineellus* Casey.—California: Los Angeles County (Casey); Mount Wilson, June 18th, (Fall); Bear Lake, San Bernardino County, June 5, 1919, (J. O. Martin); Hesperia, June 30, 1918, (J. O. Martin); Mokelumne Hill, Calaveras County, July, elevation 2300 feet, (Blaisdell); Mariposa County, June 17, 1914, (F. W. Nunenmacher).
2. *Dasytes hudsonicus* Lec.—Hudson Bay Territory. Colorado: Leadville, July 7–14, 1896, elevation 10,000–11,000 feet, (Wickham); Clear Creek, June 2, 1881, (Liebeck). Arizona (Casey).
3. *Dasytes expansus* Casey.—California: North of San Francisco (Casey).
4. *Dasytes shastensis* Blais.—California: Shasta Retreat, Siskiyou County, elevation 2416 feet, July, 1905, (Blaisdell); Clayton, Shasta County, July 13, 1918, (E. P. Van Duzee); Fairfax, Marin County, June, (Blaisdell); Mariposa County, June.
5. *Dasytes shastensis horridulus*, new subspecies.—California: Crystal Lake, San Mateo County, June 27, 1919, (Blaisdell); Mount Tamalpais, Marin County, June 25, 1919, (Blaisdell).
6. *Dasytes vicinus* Blais.—California. San Diego, (Blaisdell).
7. *Dasytes obtusus* Casey.—Colorado: Glenwood Springs, July, (Dr. A. Fenyes).
8. *Dasytes nevadensis*, new species.—Nevada: Goldfield, Esmeralda County, June 6, 1908, (F. W. Nunenmacher).
9. *Dasytes nitens* Casey.—California: Duncan Mills, Sonoma County, June 30, 1908, (Blaisdell); Samoa, Humboldt County, June 21, 1916, (Blaisdell); Marin County, (Casey).
10. *Dasytes breviusculus* Casey.—California: Sisson, Siskiyou County, July 26, 1918, (E. P. Van Duzee); Clayton, July 17, 1918, (Van Duzee).
11. *Dasytes dissimilis* Casey.—California: San Bernardino Mountains, (Fall).
12. *Dasytes musculus* Fall.—California: Mount Wilson, July 23, 1905; Pasadena, Pomona and Riverside, (Fall).
13. *Dasytes seminudus* Lec.—California: Vine Hill, Contra Costa County, June 7, 1908, (Blaisdell); Davis Meadow near Railroad Flat, Calaveras County, July, 1918, elevation 2800 feet, (Blaisdell); Mount Diablo, July 16th, W. M. Giffard); Mojave, in May.
14. *Dasytes macer* Casey.—Southern California (Casey).
15. *Dasytes cruralis* Lec.—California: Mokelumne Hill, Calaveras County, June, 1898, (Blaisdell); Shasta Retreat, Siskiyou County, July, elevation 2416 feet, (Blaisdell); Yosemite, Mariposa County, June; Mariposa County, June 16th, W. M. Giffard); Tuolumne County, May 14, 1914, (F. W. Nunenmacher); Duncan Mills, Sonoma County, July 14, 1908, (Blaisdell); Lodi and Stockton, San Joaquin County, May 14, 1911, (Blaisdell). Oregon: Colestin, Jackson County, July 31, 1918, (E. P. Van Duzee).
16. *Dasytes pusillus* Lec.—California: San Diego, (Casey); Palm Springs, Imperial County, May, (Dr. Fenyes); Mecca, Colorado Desert, April 13, 1917, (J. O. Martin).
17. *Dasytes minutus* Casey.—California. (Casey).
18. *Dasytes angulatus*, new species.—California: Mount Eddy, 9000 feet, July 28, 1918, (E. P. Van Duzee).
19. *Dasytes fastidiosus* Casey.—California: Sausalito, Marin County, April 26, 1914, (Blaisdell); Vine Hill near Martinez, Contra Costa County, June 7, 1908, (Blaisdell).

20. *Dasytes depressulus* Casey.—Nevada: (Casey).
21. *Dasytes clementae* Fall.—Island of San Clemente: (Fall).

## LISTRIMORPHA, New Genus.

*Form* of a female *Eschatocrepis constrictus* Lec., sparsely and uniformly pubescent. Pronotum without a submarginal line, lateral margins finely serrulate and feebly fimbriate; disk broadly impressed within the basal angles. Last joint of the maxillary palpi conical.

*Antennae* with a feeble three-jointed club; fifth joint larger than the fourth and angulate anteriorly nearly as in *Listrus*; joints sixth, seventh and eighth much smaller than the fifth and narrower than those of the club.

*Epipleura* rather narrow at base, gradually narrowing to become evanescent behind the middle, superior margin feeble.

*Ungual* appendages slightly longer than the length of the claws, attached nearly throughout their length; equal, subacute on the middle and posterior claws.

*Legs* slender. Claws slender. Tarsi slender, third and fourth joints together about equal to the fifth, the latter and the first subequal; second, two-thirds as long as the first. Femora not stout, somewhat compressed.

*Listrimorpha pallipes*, new species.—*Form* elongate ovate, wider posteriorly. *Color* black, somewhat dull to shining. *Antennae*, except the first joint which is dark, and legs testaceous; labrum yellowish, femora more or less piceous toward base. Surface microscopically reticulato-rugulose. Pubescence short, sparse, recumbent and pale in color, not conspicuous; elytral margins loosely fimbriate, hairs longer on the apex.

*Head* moderate, as wide as the pronotal apex; front feebly convex, feebly bi-impressed, impressions somewhat elongate, beginning on a line opposite the antennal base; vertex obsoletely impressed at the middle; very finely and sparsely punctate. Eyes rather large and somewhat strongly convex.

*Antennae* reaching to about the pronotal base; first joint smaller than in *Listrus*, second evenly oval and about equal in diameter to the first; third and fourth somewhat compressed; third obconical a little shorter than the second; fourth subtriangular (isosceles) and angulate anteriorly; fifth larger and similarly angulate anteriorly, as long as the second and distinctly larger than either the sixth, seventh or eighth; sixth smallest and about as long as wide, two-thirds as wide as the fifth, seventh a little larger and triangulo-oval; eighth about as long as the sixth and slightly wider, sides more parallel and more arcuate, about as long as wide; eleventh pointed oval and a half longer than wide.

*Pronotum* transverse, about a third wider than long, base slightly wider than the apex; sides angulate just slightly in front of the middle, thence quite straight and convergent to apex, straight, convergent or parallel posteriorly to base, margin serrulate; apex feebly emarginate; apical angles obtuse and very slightly rounded; basal angles distinct, obtuse to rectangular and somewhat reflexed; base transverse in middle two-fourths, thence oblique and feebly sinuate to the basal angles; disk moderately convex, rather evenly so in central area and at apex, more or less broadly and distinctly impressed in the region of the basal angles and along the sides to the angulation, and very feebly so across in front of the base, slightly constricted laterally behind the apex, very finely and sparsely punctate, slightly asperate in the lateral area.

*Elytra* oblong, slightly dilated behind the middle, about twice as long as wide, feebly convex on the disk, more strongly so laterally; apices slightly dehiscent, angles obtuse; finely and sparsely punctate. Scutellum transversely oblong.

Under surface of the body finely sculptured.

*Measurements.*—Length, 2.6 mm.; width, 1.0 mm.

Holotype, male, and allotype, female, in my own collection; paratypes in that of Mr. F. W. Nunenmacher.

*Type locality.*—Goldfield, Esmeralda County, Nevada. Collected by Mr. Nunenmacher on June 29, 1907. Five specimens studied.

*Remarks.*—This species is distinct in having the pronotum without a submarginal line or lateral rugose area and short ungual appendages. In Casey's table of the Melyrid tribe Dasytini it falls between *Dasytastes* and *Eschatocrepis*, and by its general facies and structural characters it is more closely related to the latter genus. From both *Listrus* and *Eschatocrepis* it can be recognized by the subangulate sides of the pronotum, the latter less convex and with serrulate lateral margins.

The fifth ventral segment has the apical margin set with a line of short and rather stiff hairs. Sexual differences are not very evident in the small series at hand.

*Listrimorpha* should precede *Eschatocrepis* in our lists.

*Dasytastes vanduzeei*, new species.—*Form* subovate. *Color* black; head, prothorax, legs and basal portion of the antennae, rufo-fulvous; metasternum more or less rufous.

*Pubescence* rather short and recumbent, quite dense on the elytra, somewhat less so on the pronotum and under surface of the body. Abdominal surface dull. Elytra feebly aeneous and maculate with several slightly elongate blackish spots, those of the apical half anastomosing to a greater or less extent.

*Front* of the head flat, finely and evenly punctate, eyes not prominent.

*Pronotum* finely and evenly punctate; apex arcuato-truncate; base arcuate; sides more strongly arcuate in the basal half, thence broadly and evenly so to apex, very slightly sinuate just before the almost rounded basal angles, serrulations small; apical angles rounded; margins fimbriate, fimbriae not long.

*Elytra* finely punctate, apical margins serrulate.

*Measurements.*—Length, 2.2 mm.; width, 1.0 mm.

*Type locality.*—Palm Springs, Riverside County, California. Collected on May 20th, by Mr. E. P. Van Duzee.

Described from two females, both in the collection of the California Academy of Sciences.

*Remarks.*—*Vanduzeei* differs from *bicolor* Casey in the color and maculation of the elytra. In *bicolor* the elytral pubescence is blackish, while in *vanduzeei* it is pale, except in spots as stated above. *Vanduzeei* should follow *bicolor* in our lists.

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*Listrimorpha*, new genus.

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# PART II.

## CHRYSOMELIDAE.

*Glyptoscelis sequoiae*, new species.—*Form* oblong-oval, broadly rounded posteriorly, moderately convex; head and prothorax narrowing anteriorly. *Color* a beautiful cupreous; antennae more or less rufous, terminal three joints black, seventh and eighth blackish in about apical half; legs rufous. Surface more or less shining, sparsely and quite evenly clothed with a rather long, soft fulvous pubescence which is recumbent, subsquamiform and linear, each hair marked with a longitudinal median stria.

*Head* and *pronotum* somewhat coarsely, regularly punctate; punctures well defined, separated by a distance equal to one-half their diameter. *Head* with an impunctate median line, front broadly, transversely but not strongly prominent at the clypeo-frontal junction, broadly and more or less moderately impressed between the eyes. Antennae long and slender.

*Pronotum* a little wider than long; sides rather evenly arcuate, moderately convergent anteriorly as viewed from above; apex quite broadly arcuate; base slightly lobed at middle, feebly sinuate laterally and scarcely wider than the disk at middle; pubescence slightly denser laterally and more hair-like centrally.

*Elytra* oblong, about one-half longer than wide, sides parallel, scarcely arcuate, and broadly, evenly arcuate in apical one-fourth; disk evidently flattened about the scutellum; pubescence appearing feebly vittate when viewed longitudinally; punctures evenly and rather closely placed, somewhat smaller than on the pronotum, finer toward apex.

*Pubescence* of under surface somewhat whitish, scarcely longer than on the supper surface, hair-like and apparently not striate. Punctuation finer than above.

*Claws* cleft. Inner division of each much shorter and smaller than the outer part, acute, especially on the middle and posterior claws.

*Male.*—Fifth ventral abdominal segment somewhat arcuately deflexed apically, and with a somewhat broad, oblong-oval impression at middle, which may be more or less impunctate at bottom.

*Female.*—Fifth ventral distinctly arcuately deflexed apically, and more or less concave throughout the width.

*Measurements.*—Length (Types), 6–7 mm.; width, 3–3.5 mm.

Holotype, male, and allotype, female, in the collection of the California Academy of Sciences. Paratypes in that of the Academy's and my own collection.

*Type locality.*—Cazadero, Sonoma County, California. Collected on April 12, 1918, by Mr. E. P. Van Duzee.

Collected from the foliage of *Sequoia sempervirens* Endl. It appears somewhat probable that when the species of *Glyptoscelis* are better known, the food plant will be found to be more or less different in case of each species. *Glyptoscelis illustris* Cr. is usually taken from yellow pine (*Pinus ponderosa* Dougl.), in the vicinity of Mokelumne Hill, Calaveras County, California; *squamulatus* Cr. is found plentifully on willow and a closely related species is found on a composite shrub growing along the San Diego River in Mission Valley, San Diego County, California. Two species were taken from juniper trees on Black Mountain (elevation 8100 feet), at Huntington Lake, Fresno County, California, during the month of July, 1919; another from fir in Humboldt County, California; finally, Mr. Van Duzee has taken the species described below from wild rose near Sacramento, California. Other phases are at hand the food plants of which are not known. Ulke has reported that the eastern species *pubescens* Fab. and *barbatus* Say are common on pine.

*Glyptoscelis parvulus*, new species.—*Form* rather short oblong-oval, robust and moderately convex; prothorax distinctly narrower than the elytra. *Color* black, with an aeneous, cupreous or virido-aeneous tinge; legs rufo-piceous, palpi and antennae more or less rufous. Surface more or less shining, sparsely and evenly clothed with rather long recumbent hair-like scales, each scale longitudinally unistriate, grayish in color.

*Head* rather strongly convex on the vertex; front broadly and feebly impressed above the scarcely prominent clypeo-frontal junction, a smooth and narrow median line more or less evident; punctuation rather coarse and sparse. Antennae moderately long and slender, joints less elongate than in *sequoiae* and similar to those in *squamulatus* and its allies, apical five joints somewhat stouter, third to the sixth subequal in length and slightly shorter than the seventh.

*Pronotum* about a third wider than long, widest at middle, rather moderately convex, strongly and precipitously declivous at the sides in region of the apical angles; apex moderately arcuate, post-ocular lobes distinct and rather strong; sides moderately, broadly and rather evenly arcuate, somewhat straight before the obtuse basal angles, as viewed from above, marginal bead distinct in basal third and more or less feeble anteriorly; base feebly arcuate; disk distinctly and somewhat sparsely punctate, punctures moderately coarse, separated by a distance equal to their diameter.

*Elytra* less than half longer than wide, rather broadly and obtusely rounded posteriorly; sides very feebly arcuate, humeri moderately narrowly rounded, umbones rather distinct; base very slightly emarginate; surface strongly transversely convex; punctuation somewhat finer than on the pronotum, punctures separated by a distance equal to about twice their own diameter, still finer on the apical declivity. Scutellum slightly transverse, apex feebly angulate, surface with a few small punctures.

*Abdomen* rather more thickly punctate than above.

*Legs* comparatively short and rather stout. Anterior tibiae quite straight; middle and posterior tibiae slightly outwardly curved at apex.

*Claws* cleft. In the male the anterior claws are cleft to slightly behind the middle; the inner divisions are one-fourth shorter than the outer part and rather acute. In the female the anterior claws are cleft to the middle, the inner divisions are short and acute, scarcely separated from the outer part; claws of the middle and posterior tarsi similar, more distinctly cleft to about basal third, inner portions longer, more slender and acute.

*Male.*—Narrower. Rather broadly impressed at middle of the fifth ventral segment, this impression impunctate or more or less sparsely punctate and pubescent.

*Female.* — Broader. Fifth ventral rather moderately concave throughout the width and apically more or less arcuately deflexed.

*Measurements.*—Length (Types), 5.5–7.5 mm.; width, 3.8–3 mm.

Holotype, male, and allotype, female, in the collection of the California Academy of Sciences; paratypes in the collection of the Academy and in that of the author.

*Type locality.*—Sacramento, California. Collected by E. P. Van Duzee, May 28, 1918. Beaten from wild rose.

*Parvulus* somewhat resembles *Adoxus vitis* Fab. in form, but is rather narrower and more elongate. The individuals vary quite a little in form, some are shorter and more robust than others and intermediates are abundant. It is the smallest species known to the author. In all species of *Glyptoscelis* examined there is a rounded setigerous fovea at the apical and basal angles of the pronotum.

In *pubescens, illustris* and *sequoiae* there is a circum-scutellar depression and an impression within the humeral umbones. The latter impression is also present in *parvulus*.

The two species here described cannot be the same as *albidus* Lec., where the pubescence is very easily removable according to Dr. Horn. A species taken in El Dorado and Calaveras Counties answers the latter peculiarity very well. In *illustris* and *squamulatus* the vestiture is quite persistent.

## TENEBRIONIDAE.

*Centrioptera pectoralis,* new species.—*Form* elongate and subparallel. *Color* black and more or less shining. Pronotum extremely finely and sparsely punctate; elytra with distinct and rather stout muricate tubercles laterally and on the apical declivity.

*Head* less than moderately convex, fronto-epistomal margin quite evenly arcuate, feebly deflexed apical margin scarcely truncate or slightly sinuate at middle; punctuation very irregular, leaving large smooth areas; punctures moderate in size and sharp across the middle of the frons and at periphery of the epistoma. Antennae slender, joints equal in width and elongate, tenth equilaterally triangular, not at all large, eleventh small and short, pointed oval.

*Pronotum* about a fourth wider than long; sides broadly and evenly arcuate in anterior two-thirds, thence broadly sinuate to the basal angles which are subrectangular, marginal bead moderately coarse and slightly reflexed; apex broadly emarginate between the rather acute and anteriorly prominent angles; base broadly and feebly emarginate; disk moderately and rather evenly convex, slightly more declivous at the apical angles, scarcely transversely impressed before the base, punctuation extremely fine and sparse, scarcely granulate or more distinct at the sides.

*Propleura* smooth, opaque with a few punctures anteriorly

*Elytra* oblong, about a half longer than wide, not strongly convex centrally but more strongly and arcuately so laterally; sides broadly and feebly arcuate, parallel, slightly wider behind the middle, apex rather broadly rounded; disk moderately convex, rather abruptly and obliquely declivous posteriorly; central area with simple punctures, laterally and on apex the punctures of the intervals are replaced by strong and moderately large muricate tubercles, the punctures and tubercles serially arranged; punctures equal in size, those of the striae not muricate and not closely placed, those of the intervals in the central and sutural area more distantly spaced and more or less granulate; base scarcely arcuate, humeri obtuse and not at all prominent.

*Parapleura* moderately coarsely and sparsely punctate.

*Sterna.*—Prosternum glabrous laterally and anteriorly along the margin, elsewhere coarsely rugoso-punctate; process broadly and slightly impressed, apex sublaminately but briefly mucronate, mucro small and variable. Mesosternum moderately declivous, then briefly vertical, very coarsely rugoso-punctate, narrowly glabrous between the coxae. Metasternum coarsely and sparsely punctate.

*Abdomen* horizontal and not strongly convex, with large glabrous and impunctate areas, punctures rather coarse, most in evidence on the process, sides and fifth segment, a few scattered across the other segments.

*Legs* rather long, moderately strongly and densely sculptured.

*Measurements.*—Length, 25 mm.; width, 10 mm.

Holotype, female, as described above, in the collection of the California Academy of Sciences. An allotype in my own collection.

*Type locality and habitat.*—San Benito Island, off the coast of Lower California. Collected July 15, 1905, by F. X. Williams, while with the Galapagos Expedition.

*Pectoralis* is distinct by its parallel form, punctuation of under surface and other characters; apparently not identical with any described in the Biologia.

In *spiculifera* Lec. the mesosternum is almost declivous anteriorly, in *pectoralis* it is strongly so, as it is in *dulzurae* described below. The mesosternum is vertical and emarginate anteriorly in *asperata* Horn, *angularis* Horn, *variolosa* Horn, *seriata* Lec. and slightly declivous in *muricata* Lec. *Pectoralis* somewhat resembles *spiculifera*, with *muricata* next in order. *Spiculifera* is a larger and broader species, with the abdomen almost impunctate and the legs more sparsely and less coarsely sculptured. In *spiculifera*, also, the mentum is transversely cordate, apex feebly emarginate, surface slightly convex and coarsely punctate, with the antennae less slender and parallel, with the ninth and tenth joints triangular, the eleventh longer. In *pectoralis* the mentum is cordate, relatively larger, somewhat concave, more strongly emarginate at apex, feebly subcarinate along the median line, longitudinally and not strongly impressed laterally, coarsely punctate and more scabrous.

*Centrioptera dulzurae*, new species.—*Form* elongate-oblong, similar to *muricata*. *Color* dull black; pronotum sculptureless, elytra with muricate tubercles laterally and on apical declivity. Mesosternum declivous anteriorly; abdomen smooth with a few scattered punctures.

*Head* slightly convex, fronto-epistomal margin arcuate, somewhat oblique laterally; surface punctate, punctures irregularly and very sparsely placed, finer in the central area. Antennae rather short with joints of equal width, joints four to eight suboblong, ninth triangular, tenth subquadrate, eleventh short pointed ovate. Mentum feebly convex, more oval than cordate, slightly transverse, apical emargination not strong; surface narrowly impunctate at apex, elsewhere rather coarsely and closely punctured, somewhat longitudinally impressed laterally.

*Pronotum* rather more than a fourth wider than long; sides broadly and evenly arcuate anteriorly, somewhat convergent and broadly sinuate posteriorly to the basal angles which are rectangular: apex truncate between the strong, anteriorly prominent and acute angles; base truncate; disk evenly and very moderately convex, a little less so basally, sculpture-

less and smooth with a few obsolete granules along the margin, lateral bead rather moderate and briefly reflexed.

*Propleura* dull, almost sculptureless and smooth.

*Elytra* oblong-oval, somewhat widest behind the middle, obliquely declivous posteriorly, less than twice as long as wide, almost flattened dorsally; sides rather broadly rounded and moderately inflexed, feebly sinuate before the apex which is slightly prominent; disk with ten series of punctures, punctures moderate in size, rather corroded, closely and slightly irregularly placed, series feebly impressed, intervals perfectly flat centrally and basally and with a single series of smaller and widely spaced, feebly submuricate punctures; laterally and on the apical declivity the intervals are scarcely convex, and with a single series of widely spaced muricate tubercles which are scarcely longer than their width at base.

*Sterna.*—Prosternum smooth and sculptureless anteriorly and laterally; process between the coxae rather broadly oval, longitudinally impressed and coarsely rugoso-punctate, apex rounded with a small mucro at tip. Mesosternum obsoletely and sparsely punctate laterally, moderately declivous and briefly vertical at middle anteriorly, coarsely rugoso-punctate, smooth posteriorly between the coxae. Metasternum smooth and very strongly punctate.

*Parapleura* smooth, sparsely and more or less obsoletely punctate.

*Abdomen* flattened throughout middle third, smooth and very sparsely punctate; process oblong-quadrate, surface with an oval and slightly raised swelling at middle, otherwise more or less rugose; first segment with a few punctures behind the coxae, fourth with a subapical line of punctures, fifth sparsely and evenly punctured, punctures somewhat coarse throughout.

*Legs* moderate in length; femora sparsely punctate; tibiae densely sculptured, each puncture with a ferruginous seta; tarsi with similarly colored setae, plantar grooves open.

*Male.*—Narrower and more parallel.

*Female.*—Slightly broader and a little inflated. (Only an abdomen at hand.)

*Measurements.*—Length (Male), 21 mm.; width, 9 mm. An abdomen of a female measures 10 mm. in width.

Holotype, male, in my own collection.

*Type locality.*—Dulzura, San Diego County, California.

*Habitat.*—Dulzura and Poway, San Diego County, California.

*Dulzurae* was identified for me as *asperata* Horn more than twenty-five years ago. For about twenty years I had only an abdomen on a pin representing this species. On my ranch at Poway, where I lived for eleven years, I took only one living specimen, but the dead bodies of this

beetle were very abundant in the nests of wood rats. *Dulzurae* is nocturnal in habits. Having secured but one living specimen in eleven years does not speak well for my ability as a collector; unfortunately I was more interested in farming at that time than in worrying over beetles.

In appearance *dulzurae* resembles *pectoralis*, which is a larger species; next in order it resembles *muricata* Lec., which is a more or less shining species, a moderate series of which is before me. In *muricata* the propleura are distinctly punctate, the abdomen is quite coarsely and much more abundantly punctate and the parapleura are more densely and strongly punctured. The pronotum of *muricata* is impressed and punctato-granulate along the side margins. *Pectoralis* is more elongate and more strongly sculptured beneath. The apparent sequence of species should be *spiculifera, pectoralis, muricata* and *dulzurae*; then follow *angularis, asperata, variolosa* and *seriata*. *Infausta* and *utahensis* I have not seen. This arrangement agrees with that given in Henshaw's List.

## **Schizillus** Horn.

In 1874, Dr. Geo. H. Horn created the above genus for *laticeps*, a member of the Tribe *Cryptoglossini*, collected on the Mohave Desert, California, by Mr. Crotch. In 1913, Mr. J. R. Slevin took a considerable series at Hesperia, California, which are in the collection of the California Academy of Sciences.

In 1908, Mr. F. W. Nunenmacher took three interesting specimens at Goldfield, Nevada. Two of these look like a modified *laticeps*, the other somewhat resembles the smooth *Cryptoglossa laevis*. For more than twenty-eight years I have had a specimen that was unique as far as my collection was concerned. During this time it was labeled *laticeps*, but it undoubtedly represents a new species. From the material before me it is evident that three new species are to be recognized.

The salient generic characters of *Schizillus* are the completely divided eyes, the transverse mentum, the broader genae and the front is hemi-hexagonal. The antennae are eleven-jointed, first joint stout and invisible from above, the terminal joint oval and smaller than the preceding. In regard to the size of the eleventh joint, I must differ from Dr. Horn, for it is smaller than the preceding. The broad head is a striking character when compared with our *Centriopterae*. Dr. Horn's description of the type species may be modified as follows:

*Schizillus laticeps* Horn.—*Form* elongate oblong-oval and moderately robust. *Color* black and subopaque.

*Head* broad, front hemi-hexagonal and moderately convex, sparsely punctured, very broadly impressed between the eyes along the frontal

suture, punctures moderately small and densest along the apical margin, neck densely and finely granulate. Antennae rather stout and parallel, the terminal four joints slightly narrower and less stout than the preceding joints.

*Pronotum* broader than long; apex moderately deeply emarginate, slightly broader than the base; sides moderately arcuate, sinuate near the base, hind angles rather less than rectangular; base broadly emarginate; surface moderately convex, sparsely punctured and subopaque and with a more or less deep, transverse, ante-basal impression; apical angles quite broad, anteriorly prominent and subobtuse.

*Propleura* sparsely punctate, punctures subobsolete, many rugulae more or less evident.

*Elytra* oblong-oval, not wider at base than the pronotum, widest at middle, sides moderately arcuate; surface moderately convex, with rows of punctures on the disk which become irregular and submuricate at the sides and apex, intervals flat and submuricately punctate; serial punctures a little larger than the interstitial; disk almost vertically declivous posteriorly.

*Parapleura* irregularly and sparsely punctate.

*Sterna.*—Prosternum sparsely punctate, more or less impunctate within the oblique sutures; process slightly produced, subevenly oval, margin prominent, surface impressed and sparsely punctate and with a few rugae. Mesosternum moderately declivous, quite deeply impressed, surface smooth and narrowly punctate along the periphery. Metasternum very short and punctato-rugose.

*Abdomen* sparsely and very obsoletely punctate; intercoxal process rugose, fourth and fifth segments distinctly punctate apically, the former glabrous in about basal half, the latter in basal third; first suture perfectly straight, the third and fourth quite strongly arcuate.

*Legs* rather short. Femora rather sparsely punctate, tibial grooves distinctly and rather more densely punctured; tibiae quite densely muricato-punctate; tarsi stout and similar in the sexes, plantar grooves open, the setae ferruginous.

*Male.*—Narrower. Abdomen feebly oblique to the sterna and slightly more flattened between the metacoxae.

*Female.*—Broader. Abdomen perfectly horizontal and slightly more convex. Elytra more broadly oblong-oval.

*Measurements.*—Length, 21–25 mm.; width, 9–11 mm.

Type in the Horn collection at the Philadelphia Academy of Sciences.

*Type locality.*—Mohave Desert, California.

*Habitat.*—Hesperia and the Mohave Desert, California.

In *laticeps* the elytral sculpturing resembles that observed in *Eleodes consobrina* Lec.; the epipleura are sparsely and very obsoletely punctate and smooth. It is a large and more elongate species with abdomen very smoothly sculptured.

*Schizillus convexus,* new species.—*Form* oblong-oval. *Color* black and more or less subopaque.

*Head* broadly and strongly transversely impressed between the antennae, vertex convex and declivous; fronto-epistomal margin somewhat hemi-hexagonal, almost evenly arcuate; surface more or less densely and irregularly punctate on the epistoma, front sparsely punctured, punctures moderately coarse. Antennae slender, joints nearly of equal width throughout, last three joints almost narrower than the preceding joints, ninth and tenth longer than wide and subtriangular, eleventh smaller and pointed-oval, a little longer than wide; apical joints with a number of rather long tactile hairs.

*Pronotum* about a third wider than long; apex slightly broader than the base, moderately deeply emarginate, margin rather straight and oblique within the angles; sides moderately arcuate in anterior three-fourths, sinuate before the base, marginal bead coarse and reflexed only near the angles; base broadly and not strongly emarginate, beaded; basal angles subrectangular; disk smooth and moderately convex, more strongly so anteriorly and centrally, moderately declivous at the apical angles, somewhat impressed within the basal angles, more or less obsoletely to distinctly punctate, punctures rather coarse and more distinct laterally; transverse ante-basal impression short, not strongly defined and slightly more impressed at middle and more strongly so within the basal angles.

*Propleura* rather coarsely, sparsely but distinctly punctate and rugose.

*Elytra* oblong-oval, widest a little behind the middle (in type), base scarcely wider than the pronotal base; surface moderately convex, strongly rounded at the sides, rows of punctures not distinct, muricately punctate throughout, more strongly so on the sides and apical declivity, the latter rather abruptly oblique; muricate punctures shining at tip and subequal throughout; apex somewhat lobed and rather broadly rounded.

*Parapleura.*—Mesosternal side-pieces distinctly and densely punctate; metasternal side pieces sparsely punctured, punctures larger.

*Sterna.*—Prosternum rather coarsely and quite densely punctate throughout; process slightly produced, rather broadly rounded at tip, marginal bead coarse and raised; surface depressed, coarsely and densely punctate. Mesosternum closely punctate, declivous, deeply impressed at middle, impression glabrous. Metasternum very short, densely punctate and rugose.

*Abdomen* more or less closely and moderately coarsely punctate, intercoxal process rugose and smooth at middle; segments more or less transversely rugose along the sides, second segment more or less glabrous in middle third, third quite glabrous at middle, fourth and fifth rather more densely punctate, fourth more or less glabrous along the base; first suture straight, third and fourth strongly arcuate.

*Legs* rather slender, posterior tibiae slightly inwardly arcuate; femora densely punctate throughout including the tibial grooves, punctures smaller than those of the abdomen; tibiae densely muricato-punctate; tarsi similar in the sexes, rather stout, plantar grooves open; terminal joints of all of the tarsi fringed with rather long and closely-placed ferruginous setae.

*Male* unknown.

*Female.*—Abdomen convex and horizontal. Elytra oblong subovate and moderately broad.

*Measurement.*—Length (Type), 23 mm.; width, 10 mm.

Holotype, female, in my own collection. A paratype in the collection of Mr. F. W. Nunenmacher.

*Type locality.*—Goldfield, Esmeralda County, Nevada. Collected June 16, 1908. Two females studied.

*Convexus*, as compared with *laticeps*, is more convex and not so broad, the body beneath is much more densely and strongly punctate, the pronotum is more distinctly punctate, especially within the angles, the mentum is less transverse, densely punctured, with the sides broadly arcuate and the surface at apex impressed so as to make the margin appear slightly emarginate.

*Schizillus nunenmacheri*, new species.—*Form* elongate, oblong-subovate. *Color* dull black, more or less opaque. Subobsoletely sculptured.

*Head* very broadly and transversely but not strongly impressed between the antennae and along the sides before the eyes; central area of the epistoma slightly prominent and convex; fronto-epistomal margin rather hemi-hexagonal; surface smooth, obsoletely punctate, except on the epistoma along the margin where the punctures are more or less distinct. Antennae quite slender, third joint very elongate, about equal to the next four taken together, joints four to eleven rather narrower than the third, about twice as long as wide, tenth slightly narrower, eleventh smaller, pointed-oval and about as long as wide.

*Pronotum* almost a half wider than long; apex rather deeply and broadly emarginate, apical angles subacute and anteriorly prominent; sides feebly arcuate in anterior one-half, thence almost straight and moderately convergent to the basal angles, marginal bead very fine to subobsolete; base broadly and feebly emarginate; basal angles sub-

rectangular; disk sculptureless, smooth, almost without impressions, central area anteriorly rather strongly convex, elsewhere moderately so, gradually declivous at the apical angles.

*Parapleura* smooth and opaque, with few rugae on the coxal convexities.

*Elytra* about a half longer than wide, suboblong-oval, widest at about the middle; base feebly arcuate, quite equal to the pronotal base; disk moderately convex, more strongly and rather broadly rounded at the sides, obliquely declivous posteriorly; apical lobe moderate and not broadly rounded; surface smooth and dull, striae obsolete or very faintly evident when viewed obliquely, interstices with a row of rather small muricate tubercles; these are obsolete along the suture, becoming gradually stronger laterally and on the apical declivity.

*Epipleura* smooth and without sculpturing.

*Sterna.*—Prosternum obsoletely rugose anteriorly and on the process, the latter a little produced, suboval with the sides converging slightly behind the coxae, tip rather broadly rounded, marginal bead not evident; surface longitudinally impressed along the middle, with few punctures along the margin. Mesosternum not sculptured, declivous anteriorly, broadly impressed at middle, sides prominent and subtuberculate. Metasternum rugose at middle, smooth laterally.

*Parasterna* sculptureless, or with a few fine obsolete punctures.

*Abdomen* obsoletely sculptured; a few very fine punctules more or less evident, few coarse punctures behind the coxae; fifth segment with very small indistinct punctures.

*Legs* rather slender, anterior pair apparently a little stouter. Femora and tibiae rather densely but not strongly sculptured throughout including the tibial grooves, the former punctate, the latter muricato-punctate. Tarsi without doubt similar in the sexes, rather stout, plantar grooves open, setae ferruginous; terminal joints of all the tarsi fringed with closely placed ferruginous setae.

*Male* unknown.

*Female.*—Abdomen convex and horizontal.

*Measurements*—Length, 18.2 mm.; width, 8 mm.

Holotype a female in my collection. Collected on Aug. 14, 1908, by Mr. F. W. Nunenmacher.

*Type locality and habitat.*—Goldfield, Esmeralda County, Nevada.

*Nunenmacheri* is distinct in its obsolete sculpturing, long third antennal joint and less rounded sides of the pronotum. The mentum is smooth and partly hidden by dried regurgitated ingesta. This species is suggestive of *Cryptoglossa laevis* on account of its smooth integuments, with the exception of the elytra; it is more elongate and less robust, the

mesosternum is different and the eleventh joint of the antennae is oval as in *Centrioptera* while in *laevis* it is short and truncate. The form is similar in *nunenmacheri* and *convexus*, but the latter is larger.

*Schizillus lomae*, new species.—*Form* oblong-oval, moderately broad and rather robust, elytra slightly flattened on the disk. *Color* black, feebly shining, somewhat alutaceous anteriorly.

*Head* moderately broad, feebly and broadly impressed between the antennae, epistoma very feebly convex at middle; surface smooth, sparsely punctate; punctures small and not strong, densely placed along the fronto-epistomal margin which is hemi-hexagonal. Antennae slender, joints of equal width, third joint a little longer than the fourth, the latter a little longer than the fifth; fifth, sixth and seventh nearly subequal, ninth and tenth somewhat compressed, tenth triangulo-oval, eleventh oval, about as long as wide, pointed at middle of tip.

*Pronotum* about a third wider than long, transverse; apex deeply emarginate, bottom of the emargination almost transverse in the middle two-fourths, thence oblique to the apical angles, which are subacute, broad and anteriorly prominent, marginal bead present within the angles; sides strongly, broadly and evenly arcuate in the anterior four-fifths, thence sinuate and parallel to the basal angles, marginal bead rather coarse and somewhat reflexed; base broadly and arcuately emarginate, bead coarse; basal angles less than a right angle, blunt and somewhat prominent posteriorly, marginal bead strong about the angles; surface smooth and obsoletely sculptured, moderately strongly convex in the central area, especially anteriorly, less so posteriorly, rather broadly impressed laterally, with a gutter posteriorly which is continuous with the short ante-basal transverse impression, the latter moderately strong; slightly impressed within the apical angles and strongly impressed within the basal angles.

*Propleura* smooth, with a submarginal line of short rugulae.

*Elytra* broadly oval, about a fourth longer than wide, dorsum rather feebly convex, strongly but not broadly rounded at the sides, apical declivity almost vertical, apical lobe short and broadly rounded; humeri obsolete, base equal to the pronotal base; scutellum very small and triangular; surface sculptured with rather close series of punctures which are simple in the central area of the disk, becoming muricate and then muricato-rugose on the lateral and apical declivities; strial punctures more closely placed and slightly larger, the interstitial series a little smaller and more widely spaced.

*Epipleura* rather wide and obsoletely sculptured.

*Parapleura*.—Mesosternal pieces rather densely punctured; metasternal pieces sparsely punctate, punctures a little larger, surface smooth.

*Sterna.*—Prosternum not strongly punctate in front of the coxae, rather transversely glabrous at middle. Process slightly produced, oval between the coxae with the sides arcuately converging posteriorly to the obtuse tip; surface broadly and feebly impressed, rather densely punctate, bead not distinct. Mesosternum arcuately declivous anteriorly, rather deeply impressed in middle third, sides coarsely punctate. Metasternum coarsely and irregularly rugose, sides sparsely punctate and rather smooth.

*Abdomen* not strongly convex, slightly oblique to the sterna; surface smooth, with widely scattered fine punctures on the first three segments; the punctures are slightly stronger on the apical half of the third segment; intercoxal process rugose; fourth and fifth segments more or less densely punctate, punctures small; first suture almost straight, third and fourth strongly arcuate, especially at the middle.

*Legs* rather long and moderately slender, anterior pair a little stouter, rather densely sculptured, femora punctate, tibiae not coarsely muricato-punctate; tarsi stout, plantar grooves open, setae ferruginous; terminal joints of all the tarsi fringed with rather long and closely-placed ferruginous setae.

*Male.*—Abdomen not strongly convex and slightly oblique to the sterna.

*Female.*—Unknown.

*Measurements.*—Length, 20 mm.; width, 10 mm.; elytral length, 13 mm.

Holotype, male, in my collection. Collected by Mr. O. N. Sanford.

*Type locality* and *habitat.*—Point Loma, San Diego, California.

*Lomae* is very distinct from the other species. The mentum is cordato-oval, slightly transverse, apex slightly emarginate, lobes arcuately rounded into the broadly arcuate sides; surface distinctly but not strongly convex, closely punctured, punctures moderate in size.

The scutellum in the Tenebrionidae as a rule is a very unreliable and variable structure in any well defined species. In *Schizillus* it enters between the elytra but a short distance. The scutellum is more or less triangular, short and more transverse in *laticeps, convexus* and *nunenmacheri.* In the type of *lomae* it is small and equilaterally triangular.

The following table will serve to separate the species of the genus *Schizillus*:

Humeri obsolete, elytra broadly oval.....*lomae*, n. sp.
Humeri more or less distinct, elytra oblong oval..... 1
1. Third antennal joint very elongate, about equal in length to the four following joints.....*nunenmacheri*, n. sp.
–. Third joint shorter than the next two taken together..... 2
2. Abdomen very finely and sparsely punctate.....*laticeps* Lec.

–. Abdomen very distinctly, rather closely punctured, punctures moderate in size.....*convexus*, n. sp.

The following antennal differences may be noted:

Third joint a little longer than the fourth, the latter relatively longer than in *laticeps* ..... *lomae*

Third joint about equal to the next four taken together, these being subequal in length and about a third longer than wide.....*nunenmacheri*

Third joint about twice as long as wide, distinctly shorter than the next two taken together; fourth, fifth and sixth subequal in length.....*laticeps*

Third joint distinctly twice as long as wide, fourth longer than the fifth.....*convexus*

*Euschides lecontei* Horn.—This species inhabits the valleys and foothills of the southern San Joaquin Valley. To what altitude in the foothills is not definitely known. Series are before me that were collected near Los Angeles and at Bakersfield. There is a noticeable difference between the extremes of the two series. In the Bakersfield specimens the males are comparatively slender and quite parallel, the elytra are distinctly narrower than the pronotum; in the female the elytra are broader and distinctly wider than the pronotum, with the sides moderately arcuate; in both sexes the dorsum is less convex than in the Los Angeles specimens. In the latter the males are less narrow and parallel, the elytra being at least as wide as the pronotum, with the sides broadly and more strongly arcuate than in the Bakersfield males; in the females there is often present a short costa between the margin and the second discal, these costae are not strong and are usually obsolescent; both sexes are more robust and the dorsum more convex.

In both series the sculpturing is similar and the variations are analogous in every way. The surface lustre is somewhat duller in the Bakersfield specimens. The characters appertaining to the two series as mentioned above, gradate completely one into the other. The largest specimen mentioned by Casey measured 20 mm.

In the collection of the California Academy of Sciences is a specimen, as well as one in my own, that was collected in the Kings River Canyon, California, both taken by Mr. Frank Daggett; these two specimens are giants as compared to the other specimens seen by me. They measure as follows: Length, 24–25 mm.; width, 10–10.3 mm. In these the discal costae become obsolescent before becoming coalescent on the apical declivity and there is no evidence of a third costa. The pronotum is transverse, disk more convex and less deplanate at the sides, the central area is smooth, sparsely punctate, punctures smaller, less strong, becoming coarser laterally and on the deplanate area more or less punctato-rugose, and the margin is less reflexed than in the two series mentioned above; the base is nearly arcuate, scarcely bisinuate; the head has a large cordate depression. The legs are relatively stouter than in the Los Angeles and

Bakersfield specimens; in the former they are stouter than in the latter, where they are quite slender. In both the Bakersfield and Los Angeles specimens the antennae are slender and the last three joints form a club; in those from Kings River Canyon the antennae are stouter and gradually incrassate and the under surface of the body is more coarsely and densely punctate. For this large phase I propose the name *gigantea*, new subspecies. Among the specimens referred to these three series there are the usual individual variations observed in other species, and, when these are arranged in a block system, the gradations are complete. These forms are the result of geographical position and environment which produce such modifications and reveal the plasticity and adaptability of the organisms.

*Coniontis santarosae*, new species.—*Form* oblong-oval, about twice as long as wide, rather more than moderately convex. *Color* black, tibiae and tarsi piceous, surface smooth and shining; pubescence microscopical above, longer and more abundant beneath.

*Head* very finely and sparsely punctate, punctures stronger and more numerous on the epistoma; frontal suture distinct; epistomal sinuation moderate and arcuately reëntrant. Antennae shorter than the length of the pronotum, three terminal joints subequal in size and moderately compressed, scarcely wider than the preceding joints.

*Pronotum* almost twice as wide as long, evenly arcuate from side to side, more strongly arcuate and declivous at the apical angles; sides not strongly convergent anteriorly, feebly arcuate, more strongly so in apical one-half; marginal bead fine; apex arcuate in circular arc, almost truncate when viewed from above, finely beaded, but less so at middle; base almost truncate, very feebly sinuate laterally, angles scarcely more prominent posteriorly than the broad and very feebly arcuate median lobe; basal angles subrectangular; apical angles obtusely and narrowly rounded; disk with sparse and extremely fine punctules, each with a microscopical hair.

*Elytra* oblong, about a third longer than wide, evenly arcuate transversely, more gradually so on the apical declivity; surface smooth and polished, sometimes very finely wrinkled, feeble grooves and costae sometimes noticeable; each puncture with a microscopical hair.

*Prosternum* feebly and sparsely punctured, with numerous pseudopunctules scattered throughout; process finely margined on apex or not.

*Abdomen* very sparsely and finely punctulate.

*Male.*—Somewhat narrower. Pronotum relatively broader. Abdomen less convex.

*Female.*—Broader. Pronotum relatively narrower. Abdomen more convex.

*Measurements.*—Length (Types), 12.0 mm.; width, 6.0–6.5 mm.

A series of fifty-two specimens studied.

*Variations.*—These include those of size, slight cuneateness in some males, feebler and stronger punctuation and rugulosity of the elytral surface, margining of the prosternal process not constant; posterior canthi of the eyes not always the most prominent, occasionally stronger on one side and feebler on the other.

Extremes in size measure as follows: Length (Male), 9.0 mm.; (Female), 12.5 mm.; width, 4.0–6.5 mm.

Holotype, male, and allotype, female, in the collection of the California Academy of Sciences; paratypes in the same and the author's collection.

*Type locality.*—Santa Rosa Island, off the coast of Southern California. Collected by Mr. Van Duzee, May 20, 1919.

*Habitat.*—Santa Rosa and San Miguel Islands. Mr. Van Duzee says: "Found under dry 'cow-chips' near the entrance to the pier on Santa Rosa Island, where they seemed to be abundant."

*Santarosae* was at first referred to *Coniontides infinitimus* Casey, as that species according to its author is more elongate than *latus* or *insularis*. The habitat of *infiinitimus* is uncertain but Casey believes it to be the Island of Santa Rosa. The form of the pronotal base in *santarosae* forbids any association with the *Coniontides*. Its general facies associates it with the *viatica* group while the measurements suggest the *robusta* group. These groups are arbitrary and can only be used as a convenience.

The mentum in *santarosae* is transverse, lobes obtusely angulate at apex, sides arcuate; apex broadly sinuate in the middle three-fifths, sinuation more or less moderate in depth and arcuately reëntrant; surface feebly convex, slightly asperate and irregular on the lobes, more or less impressed at base within the broad margin and sparsely and more or less regularly punctate, the punctures shallow and each with a short yellow hair.

*Coniontis musculus* Blais.—One of the most important things relating to the study and knowledge of organisms is habitat. Habitat, when known, makes it possible to correlate the effect of geographical position and environment on the organisms of different regions. In the majority of cases when that knowledge is lacking it is folly to describe a species or race, all data accredited to such a species is presumptive or a pure postulation and without scientific value. Especially is this true in cases of organisms that are particularly variable as regards individual form and sculpturing, as in such genera as *Coniontis, Eleodes, Pterostichus* and many others.

In the collection of the California Academy of Sciences there are specimens of a species of *Coniontis* which must be referred to *musculus* Blais. These specimens were collected in the Kings River Canyon by Mr. Frank Daggett, no altitude is given and this is a stumbling block to a correct understanding of these specimens. *Musculus* inhabits the San Joaquin Valley as far south as Tehachapi, and westward and eastward into the foothills, to just what altitude it attains is not known. *Musculus* appears to be exceedingly abundant in Ventura County, especially in the vicinity of Oxnard. The specimens from this latter locality show some deviation from the typical form from the more northern limit of its distribution. So it is with the specimens from the Kings River Canyon; these are relatively narrower, and therefore less robust than the true *musculus*. If all of the specimens that I have seen referable to *musculus* could be arranged in a block system, the observable differences would become evanescent, for a few individuals from each locality would resemble similar ones from other places. It is often the general habitus or facies in the broad sense that should guide in the limitation of species in such genera as *Coniontis, Eleodes* and others.

Genus *Coniontides* Casey.—A series of sixty-nine specimens in this genus are before me. They were collected on the different islands off the coast of Southern California, namely: San Clemente, Santa Rosa, Santa Barbara, Santa Cruz, Anacapa, Prince and San Nicolas; on the mainland near Los Angeles a small series was taken by Dr. E. C. Van Dyke.

The character that gives *Coniontides* any claim to generic standing, is "the marked prolongation backward of the thoracic angles, recalling the *Eusatti*, and in every way similar to the form there prevailing" (Casey), and in the insular habitat; Dr. Van Dyke's series, however, shows that the species are not entirely confined to the islands. *Coniontides* has as much claim to generic standing as has *Coniontellus*; in the latter the eyes are completely divided by the sides of the head, otherwise it is similar to *Coniontis*. In *Coelus* and *Coelotaxis* the first joint of the anterior tarsi is prolonged beneath the second, but in the former it is much longer. I see no reason why *Coniontides* should not remain as a valid genus.

*Coniontides latus* Lec.—As usual in a large series, there is great variation in size and sculpturing. The condition of cuneateness possessed by many males is not a group, a generic, nor a specific character. It is observed in all species and races of *Coniontis*. Body form or outline varies greatly and between the extremes all degrees of intermediates are found.

The connectants invalidate any particular value assigned to a given form. The prosternal process is usually unmargined, some specimens,

however, have it margined and all degrees exist between the extremes. The mentum presents great variation as regards sculpturing; some specimens have the lobes quite deeply concave or impressed with the surface subcarinate in the median line and rather coarsely punctured throughout; others have the surface feebly convex, not at all impressed, but punctate as indicated above, or more or less glabrous at the apical sinuation. All intermediate degrees are at hand. Punctuation is the only character available for subdividing the species into races. Here the separation is artificial, arbitrary and opinionative.

In *latus* the elytral punctures are almost as coarse as are those of the pronotum and the surface lustre is dull. Specimens collected November 3, 1916, on the Island of San Clemente are before me.

*Clementinus* Casey is only an individual variation, a certain number of specimens can be selected to constitute a group. This phase is identical with *latus* and the name falls in synonymy.

In the race *insularis* Casey the surface is more shining and the elytral punctures are finer, the pronotal punctures are also a little smaller than in *latus*. The characters presented by this phase gradate into those of *latus*.

*Infinitimus* Casey has not been recognized in the material before me. The habitat is uncertain but Casey believes the type came from the Island of Santa Rosa. A large series of specimens collected by Mr. Van Duzee on this island prove to be a true *Coniontis*, for the pronotal base is almost truncate from angle to angle, and is described in this paper as *santarosae*. More work will be done on the anatomy of these forms.

The specimens collected by Dr. Van Dyke at Los Angeles represent a species which may be described as follows:

*Coniontides vandykei*, new species.—*Form* elongate oval, about twice as long as wide, moderately convex; surface moderately shining. *Color* black, legs and tarsi, antennae and mouth-parts more or less rufo-piceous.

*Head* quite evenly punctate, punctures well defined and not densely placed, rather more numerous anteriorly; epistomal sinuation shallow and arcuately reëntrant. Antennae rather short, about two-thirds the length of the pronotum; outer joints scarcely wider than the preceding and moderately compressed.

*Pronotum* rather more than a third wider at base than long, moderately and evenly convex throughout; sides moderately arcuate, more strongly so anteriorly, apex three-fifths the width of the base, lateral bead rather fine, that of the apex very fine, base not beaded; disk finely and not very distinctly punctate, punctures rather evenly but not closely placed.

*Elytra* evenly, moderately convex; surface very finely and less distinctly punctate, punctures finer than those of the pronotum, becoming stronger with slight rugulosity on the apical declivity.

*Prosternum* not strongly punctate, punctures rather close, sparse on the process, which is not margined at tip.

*Abdomen* finely, rather evenly and closely punctate, denser on the fifth segment.

*Male.*—Somewhat narrower; pronotum relatively broader; abdomen less convex.

*Female.*—Slightly broader; pronotum relatively narrower; abdomen more convex.

*Measurements.*—Length, 10 mm.; width, 5 mm.

*Type locality.*—Near Los Angeles, California. Collector, Dr. E. C. Van Dyke.

Holotype, female, in the author's collection; paratypes in the collection of Dr. Van Dyke.

*Habitat.*—Dr. Van Dyke states that it occurs near Los Angeles, at the entrance to the Griffith National Park.

This is the first instance of finding a *Coniontides* on the mainland. The characteristics of *vandykei* are the finer punctuation and less robust facies. Seven specimens have been studied.

*Eusattus difficilis* Lec.—A large series of this species is before me which was collected at San Diego and Coronado, in 1890 and 1891, during the months of October, November, April and June. Part of the series was taken by Mr. O. N. Sanford and Mr. G. W. Dunn. Casey gives San Diego as the habitat of this species. My series gives an amazing amount of variation in the characters used by taxonomists for the separation of species. Casey considers epipleural characters of generic value and states that Horn goes so far as to give such trivial characters as the margination of the prosternal lobe precedence over the epipleural structure (*Proc. Washington Acad. Sciences*, **10**, 65, 1908). I am discussing here intraspecific, not generic, characters. Margination of the prosternal process is just as valuable in *Eusattus* as it is in *Coniontis*, and it is of no positive value in either; but is helpful in a limited number of species. Are differences only to be considered in the recognition of species, and must a preponderance of resemblances be overlooked with taxonomic acumen? Study a series of *Blapstinus, Coniontis, Elcodes, Cryptadius, Metoponium, Telabis, Melanastus, Coelocnemis*, etc., taken from a limited area of territory and what are ostensibly the same species; compare them character for character, sex for sex. Do they appear to have been cast in exactly the same mold? Does not the punctuation vary, also the margining of the prosternal process, body form, relative length of the appendages in the

different individuals? So it is with my series of *Eusattus difficilis*, taken on the same small peninsula, about the same bay, same climate and at different seasons. They vary in surface lustre, from opaque to somewhat shining, prosternal process fully margined to not at all, elytra with irregular and more convex longitudinal lines or none at all, sides of the pronotum noticeably declivo-explanate to scarcely so, pronotal disk with small but distinct punctures or obsoletely punctate, prosternal process narrow or broader,—all these variations are present in my series of specimens, they gradate one into the other. So far the diagnosis is clear.

In the collection of the California Academy of Sciences there are a few specimens of *Eusattus* taken on San Martin Island, Lower California, July 11, 1905, by F. X. Williams while on the Galapagos Islands Expedition. These specimens agree, character for character, with certain of the specimens collected at San Diego. The individuals of the small series differ among themselves, the pronotum is distinctly declivo-explanate laterally in one, scarcely so in another and to an intermediate degree in another. The most surprising thing is that I cannot separate them by any character from a specimen taken by Mr. Frank Daggett, in the Kings River Canyon, California. The San Martin Island specimens are smaller and rather more oblong than the average *difficilis*, but agree in these characters with a minority of specimens from San Diego. Does geographical position make the San Martin Island specimens a distinct species from those taken at San Diego? Or, am I right in my conclusions that they are all of one species—namely, *difficilis?*

*Eusattus vanduzeei*, new species.—*Form* oblong-oval, strongly convex, and about one-half longer than wide. *Color* deep black, surface smooth and shining.

*Vertex* of the head quite impunctate, elsewhere rather evenly and not closely punctate, punctures rather less than moderate in size, densest on the epistoma, the latter triangularly sinuate at middle, angles rounded into the arcuate sides, which are feebly or not sinuate at the oblique sutures, the latter may or may not be evident; frontal suture more or less distinct and arcuate between the oblique sutures; margin of the epistomal lobes slightly reflexed.

*Pronotum* strongly convex from side to side, quite obliquely declivous laterally and rather more than narrowly explanate at the sides; apex and side margins finely beaded, base not beaded but sinuate laterally, median lobe broad and feebly arcuate; basal angles obtuse and rather narrowly rounded; apical angles subobtuse; disk sparsely punctate laterally, punctures fine and subobsolete in the central area, coarser laterally; sides ciliate.

*Elytra* with very fine remotely spaced punctures; inflexed sides more distinctly punctured and sometimes subasperately so, each puncture with a rather long hair; surface sometimes more or less finely wrinkled.

*Epipleura* finely punctured, each puncture with a hair as on the inflexed side of the elytra; gradually wider from apex to base.

*Body* beneath pubescent, each puncture bearing a hair. Inflexed sides of the pronotum fimbriate with long fulvous hairs. Pubescence longest on the sterna and femora.

*Prosternum* asperato-punctate, with abundant hairs; process margined throughout; surface smooth and impunctate between and behind the coxae.

*Abdomen* very finely and remotely punctulate, punctules most abundant laterally and on the fifth segment, hairs short and scarcely evident centrally.

*Anterior tibiae* very finely serrulate on their external edge.

*Male.*—Somewhat narrower. Pronotum usually as wide as or slightly wider than the elytra. Abdomen less convex.

*Female.*—Broader and slightly more inflated. Pronotum as wide as the elytra or slightly narrower. Abdomen more convex.

*Measurements.*—Length (Types), 12 mm.; width, 7.0–7.5 mm.

A series of seventy-seven specimens studied. The individuals are quite uniform as regards shape, although one variant is subovate, narrowing anteriorly, with the pronotum distinctly narrower than the elytra, but continuing the side lines of the elytra. Several specimens have the elytra distinctly more or less crinkled. The extremes in size measure as follows: Length, 11–13 mm.; width, 7–8 mm.

*Type locality.*—Prince Island, off the coast of Southern California. Collected by E. P. Van Duzee on May 20, 1919.

Holotype, male, and allotype, female, in the collection of the California Academy of Sciences. Paratypes in the collection of the Academy and that of the author.

*Habitat.*—Prince and Santa Rosa Islands, off the California coast south of Santa Barbara County.

This fine species is dedicated to its discoverer. There has been some doubt as regards its relation to *politus* Horn, found at Santa Barbara. While *vanduzeei* is undoubtedly related to *politus*, it can not be identical if the published descriptions are complete. In *vanduzeei* the sides of the pronotum are fimbriate, the inflexed sides of the elytra and epipleura clothed with fulvous hairs, and the under surface of the body is more or less pubescent throughout. The sides of the pronotum are somewhat explanate. These characters are not mentioned as possessed by *politus* Horn. In *vanduzeei* the size and form are apparently different.

Mr. H. C. Fall has made the necessary comparisons at Cambridge, and found two examples referred to *politus*. "The second specimen is not *politus* at all. The first bears the name label in Horn's handwriting and is evidently one of his type series. It is rather old and worn, hence the setae are not well preserved. They are present, however, on the inflexed sides of the thorax, but appear to be practically absent from the epipleura, nor is there any evidence of setigerous punctures to show where they may have been, except possibly two or three very small ones." He further states that "the punctuation of the upper surface is distinct enough though sparse and fine. Your specimens are distinctly smoother."

Mr. Van Duzee states that the specimens were "taken on the steep southern slope of Prince Island at the entrance to the harbor of San Miguel Island. They were found beneath prostrate weeds more or less imbedded in light sandy soil brought down by the small surface washes. In the right kind of soil they were not uncommon, an hour's work yielding about seventy specimens.

The mentum in *vanduzeei* is transverse, with the apex broadly sinuate, sinuation nearly semicircular at middle third, thence oblique and feebly arcuate to the tips of the lobes, the latter are obtusely rounded; sides distinctly arcuate; surface nearly impunctate centrally, broadly impressed laterally on the lobes and punctate, impression deep at base; each puncture bearing a yellow seta; lateral bead thick.

In *Eusattus difficilis* the surface of the mentum is feebly convex, nearly impunctate, with only a few scattered punctures; otherwise as in *vanduzeei*. The mentum is still smoother in *Eusattus reticulatus* Say.

*Female genital segment.*—Each valve consists of a dorsal, a lateral plate terminating in the apex, and a ventral plate. *Lateral plate* strongly chitinized, dilated at base but continuous with the less chitinized dorsal and ventral plates; surface with very sparse punctures, each with a long hair; apex slightly recurved, flattened dorso-internally, feebly convex on the ventro-lateral surface; the rather elongate oval fossa bears a pencil of about eight long hairs situated near base of the apex; fossa membranous at bottom; tip of apex strongly chitinized and narrowly rounded. *Dorsal plate* pale in color, not moderately chitinized, internal border apparently arcuate, reaching to a point about midway between the fossa and tip of apex; surface coarsely and rather closely punctate, each puncture bearing a long hair. *Ventral plate* narrower and elongate, pale in color and not strongly chitinized, reaching to a point opposite the tip of the ventral plate; surface densely and coarsely punctate, each puncture bearing a long hair. Dorsal and ventral plates blend with the lateral plate. Described from the dried specimen.

*Eleodes rotundipennis* Lec.—Recent studies demand that *rotundipennis* be raised from the grade of variety to that of a valid species, with the following brief diagnosis: *Pronotal* sides evenly and broadly rounded (as in *parvicollis*), basal constriction short and the angles rectangular. Otherwise as in *cordata* Esch. It should follow *scabrosa* Lec. and precede *cordata* in our lists. For further remarks see the author's Monograph of the Eleodiini (*Bull. 63, U. S. Nat. Mus.*).

*Habitat.*—Oregon (Koebele); British Columbia (Victoria and North Bend.—Hubbard and Schwarz); State of Washington (Easton and Olympia).

*Eleodes rotundipennis versatilis*, new variety.—*Form* elongate suboblong, not strongly convex and a little more than twice as long as wide. *Color* piceous to deep black, more or less shining. Pronotum rather strongly and moderately coarsely punctate, punctures irregularly distributed, leaving small smooth areas; disk flat between punctures. Elytra muricato-tuberculate, scarcely rugose.

*Head* feebly convex, rather closely punctate, punctures rather less than moderate and more or less evenly distributed; impressions broad, shallow and within the antennal prominences. Antennae rather long, slightly incrassate; ninth and tenth joints slightly transverse, eleventh subtrapezoidal.

*Pronotum* rather transversely oblong, moderately and evenly convex, widest at middle; disk quite evenly convex, punctures more or less discrete, moderate in size and distinct, irregular in distribution, leaving small glabrous areas, slightly denser laterally and feebly subasperate, intervals flat; sides rather evenly and broadly arcuate in anterior five-sixths, suddenly constricted at base, where the sides are straight and parallel, marginal bead fine; apex feebly emarginate in a circular arc; apical angles obtuse and not in the least prominent; base truncate, equal to the apex; basal angles rectangular.

*Propleura* opaque, sparsely and muricately punctate.

*Elytra* distinctly oblong-oval, moderately convex, widest in the middle third; base truncate, scarcely wider than the pronotum, humeri distinct and obtusely rounded; sides evenly and not strongly arcuate, obliquely converging to apex in apical third, apex obtusely rounded; disk arcuately declivous at apex, evenly and not very closely muricately punctate but not strongly so, punctures becoming quite tuberculate laterally and on apex, tubercles shining at summit.

*Abdomen* rather strongly and densely punctate, except on the fourth and fifth segments, which are finely punctate.

*Legs* moderate in length; anterior femora mutic as usual in the subgenus. Anterior and middle tarsi dissimilar in the sexes.

*Male.*—Somewhat narrow and parallel, antennae extending to or just beyond the pronotal base. Abdomen moderately convex, slightly oblique to the sterna, somewhat flattened along the middle. First three joints of anterior tarsi with small subacute tufts of yellowish pubescence at tips beneath, that of the third joint smaller than the others; first two joints of the middle tarsi with similar and smaller tufts.

*Female.*—More robust. Abdomen more convex. First joint of the anterior tarsi slightly thickened at apex beneath, plantar groove more or less distinct throughout.

*Measurements.*—Length, 14.5 mm.; width, 6 mm.

Holotype, male, in the collection of the California Academy of Sciences. Paratype in the academy's and the author's collection.

*Type locality.*—Colestin, Jackson County, Oregon. Collected July 30, 1918, by E. P. Van Duzee; one specimen taken at Easton, Washington.

*Versatilis* was one of the puzzling forms studied at the time the Monograph of the Eleodiini was written, and no decision was reached. Two closely related forms are still doubtful, these having been collected in central and southern California.

*Versatilis* has the pronotum of *parvicollis* and the sculpturing of *cordata*.

*Eleodes dentipes marinae*, new variety.—*Form* moderately robust, oval to ovate and almost subfusiform, convex and very smooth, punctuation fine and distinct; punctures subequal throughout.

*Head* feebly convex, impressions obsolete, punctures rather irregularly distributed. Antennae rather short, not reaching to base of the pronotum, gradually incrassate to tip, ninth and tenth joints transverse, eleventh obliquely truncate at apex.

*Pronotum* widest at middle, about two-sevenths wider than long; disk rather evenly and strongly convex, rather strongly declivous at the apical angles, finely, distinctly, not closely punctate throughout; punctures equal in size and distinct to the margin, lateral bead fine; sides evenly and moderately strongly arcuate in anterior two-thirds, thence straight and convergent almost to the basal angles, which are slightly prominent laterally, making the margin feebly sinuate just in front of them; apex broadly and feebly emarginate, feebly arcuate in middle third; apical angles short, rather stout, somewhat prominent, sometimes more or less everted; base feebly arcuate.

*Propleura* smooth, feebly, sparsely punctate and more or less rugulose.

*Elytra* oval, widest at middle, smooth, quite evenly convex from side to side; punctuation fine, punctures evenly distributed, not close and equal

in size, diffuse or with striae of punctures more or less evident; base feebly emarginate; disk rather gradually and arcuately declivous apically, the apex obtusely rounded; sides arcuate throughout, converging to apex.

*Abdomen* finely and sparsely punctured.

*Legs* moderate in length.

*Male.*—Narrower, elongate, subfusiform oval. Elytra gradually narrowed posteriorly, rather gradually and arcuately declivous apically; apex obtusely rounded, sometimes feebly divergent at tip. Abdomen moderately convex, first two segments scarcely impressed or flattened. Anterior femora with a slender and well developed tooth. Posterior femora slightly arcuate, gradually widened toward apex.

*Female.*—Rather robust. Elytra more or less broadly oval, rather strongly although gradually declivous posteriorly; apex rather more broadly rounded. Abdomen rather moderately and evenly convex. Anterior femora with an obtuse tooth, posterior quite straight.

*Measurements.*—Length (Types), 22–24 mm.; width, 8.2–9.5 mm.

Holotype, female, and allotype, male, in the collection of the California Academy of Sciences. Paratypes in the Academy's and the author's collection.

*Type locality.*—Fairfax, Marin County, California, March 9, 1919; E. P. Van Duzee, collector.

*Habitat.*—As far as known, found only in Marin County, California.

A moderate series has been studied. *Marinae* caused considerable trouble until Mr. Van Duzee took a colony which adhered to a common type form. *Marinae* should precede *confinis* Blais. in our lists. In *confinis* the pronotal sides posteriorly are straighter to the angles than in *marinae*; there is a shallow and broad sinuation in front of the basal angles, the latter being somewhat prominent laterally in *marinae* while in *confinis* the angles are not at all prominent; in *confinis* the punctuation is fine and indistinct; in *marinae* it is less fine, distinct and well defined.

*Eleodes laticollis apprima*, new subspecies.—Since the publication of the Monograph of the Eleodiini, a large series of specimens of what was then referred to *Eleodes laticollis forma insularis*, has been studied and the resulting conclusion is that it is a valid subspecies and should be raised to that grade, as indicated above. The material at hand includes collections made on San Nicolas, Prince, San Clemente, Santa Barbara, Anacapa and San Miguel Islands. Material ample enough to force a change of opinion.

In *apprima* the pronotum is as a rule a little longer when compared with the width, notably shining, and the form is more elongately robust. The individuals vary in every way as they do in *laticollis*.

*Measurements.*—Length (Types), 18–20.5 mm.; width, 10–12.5 mm.

Holotype, female, and allotype, male, in the collection of the California Academy of Sciences; paratypes in the Academy's and the author's collection.

*Type locality.*—San Nicolas Island, March 28, 1918; J. R. Slevin, collector.

The characters are quite similar in *laticollis* and *apprima*; the former has a relatively more transverse pronotum and is usually dull in lustre.

*Eleodes sanmartinensis*, new species.—*Form* elongate, oblong-oval to suboblong-oval. *Color* black and more or less shining; surface smooth.

*Head* about as long as wide, equal to one-half the width of the pronotum; front slightly convex, punctures small and irregular in distribution, sparse centrally and denser laterally. Antennae extend slightly beyond the base of the pronotum, feebly incrassate apically, last three joints scarcely wider and more or less globular.

*Pronotum* about a fifth wider than long; sides evenly and broadly arcuate from apex to base, marginal bead more or less moderate and slightly reflexed; apex more or less truncate between the rather small and more or less everted apical angles, finely beaded, bead more or less obsolete at middle; base truncate, rather finely and evenly beaded; disk evenly and moderately convex, rather narrowly impressed along the sides, punctuation fine and more or less obsolete, except laterally where the punctures are more distinct and slightly punctato-rugulose on the impressed area, surface smooth; basal angles obtuse and more or less distinct.

*Propleura* smooth and obsoletely rugose.

*Elytra* more or less oval, humeri obsolete; sides evenly arcuate, in apical fourth evenly converging to the obtuse apex; base transverse; disk smooth and more or less indistinctly sculptured; punctures small and subequal, not in the least asperate, apparently more or less serial in arrangement, double series sometimes present.

*Parapleura* more or less coarsely punctured.

*Sterna* not strongly sculptured.

*Abdomen* smooth, finely and sparsely punctate, punctures denser on the fifth segment, more or less rugulose.

*Legs* long, femora heavy and markedly compressed, anterior femora dentate; tibiae densely punctato-muricate. Tarsi apparently similar in the sexes.

*Male.*—More or less parallel and elongate oblong-oval. Elytra not wider than the pronotum, more gradually declivous posteriorly. Femora notably stout, long and compressed, the anterior distinctly swollen, tooth at outer fourth, subcylindric, everted and backwardly curved, resulting

apical sinus more or less arcuately narrowed; metatibiae quite straight. Abdomen notably flattened and moderately oblique to the sterna.

*Measurements.*—Length, 22.9 mm.; width, 9.5 mm.

*Female.*—Suboblong-oval, elytra moderately inflated, distinctly wider than the pronotum, more abruptly declivous posteriorly. Femora less stout, tooth of profemora less stout, sinus more open. Abdomen moderately convex and on the same plane with the sterna.

*Measurements.*—Length, 26 mm.; width, 11 mm.

Holotype, female, in the collection of the California Academy of Sciences. Allotype, male, in the author's collection.

*Type locality* and *habitat.*—San Martin Island, off the coast of northern Lower California, July 11, 1905; F. X. Williams collector.

*Sanmartinensis* differs from *laticollis* subspecies *apprima* in the broadly rounded sides of the pronotum, without basal constriction. An unusual character in the *dentipes* and *laticollis* sections of the genus. The general form is that of a male *grandicollis* Mann.

*Eleodes sanmartinensis moesta*, new variety.—*Form* elongate ovate, surface lustre dull, elytra sparsely and muricately sculptured.

*Sides of head* in front of the antennae rather rapidly converging, frons rather flat, sparsely, finely and distinctly punctate. Antennae rather short and slender, ninth and tenth joints transversely oval, eleventh truncate oval.

*Pronotum* a little wider than long; sides broadly arcuate, somewhat more strongly so in anterior half, thence somewhat straight to the basal angles; punctuation of the disk fine, sparse and distinct.

*Elytra* suboval, humeri obtuse but distinct; disk feebly flattened in the central area, punctuation consisting of small, distinct granulate punctures; granules shining on summit; each puncture with a distinct black semi-erect seta, punctures serially arranged in the central part of the disk with an interstitial and more widely spaced row; punctures fine, becoming rather coarse and asperate on the sides and apical declivity; sides rather broadly arcuate, somewhat oblique in apical fourth to apex, the latter obtuse.

*Legs* densely sculptured and comparatively short.

Otherwise as in *sanmartinensis.*

*Female.*—Abdomen convex; femora normal in thickness.

*Measurements.*—Length, 21 mm.; width, 9.5 mm.

Holotype, female, in the collection of the California Academy of Sciences.

*Type locality* and *habitat.*—San Martin Island, off the coast of northern Lower California. Collected July 11, 1905; F. X. Williams, collector.

*Moesta* bears the same relation to *sanmartinensis* that var. *minor* does to *laticollis* Lec. There is a slight indication of an obtuse salient at apical fourth of the mesofemora. The present race is based on analogy that has been observed in series of many species. *Moesta* differs so radically in sculpturing from the type species that it can not be considered as heterotypical and therefore a *form*.

*Eleodes mutilata*, new species.—*Form* elongate ovate to fusiform ovate, convex. *Color* black, surface smooth, femora edentate; legs slender and moderate in length.

*Head* moderately small, rather short, front moderately convex, epistomal suture fine and more or less impressed; surface smooth, very finely and sparsely punctate. Antennae long and slender, reaching about two joints beyond the pronotal base; joints four to eight inclusive elongate and subequal, ninth and tenth triangulo-oval, eleventh obovate, pointed at apex and about as long as wide, last three joints scarcely wider to slightly so.

*Pronotum* quadrate, a little wider than long; apex broadly and not strongly emarginate between the anteriorly prominent angles, the latter subacute and rather broadly subdentiform; base broadly and feebly arcuate, apex and base obsoletely beaded; sides broadly and not strongly arcuate, very slightly sinuate behind and before the apical and basal angles, the latter subobtuse and not at all prominent, marginal bead very fine, almost subobsolete; disk rather strongly, evenly convex and impunctate, or with fine, sparse and subobsolete punctures.

*Propleura* sparsely and obsoletely punctate and rugose.

*Elytra* oval to subfusiform-oval, rather strongly convex, sometimes slightly flattened on the dorsum; sides evenly arcuate, slightly more oblique in apical third, apex obtusely rounded; disk smooth, obsoletely sculptured, punctures small and subequal in size throughout and arranged in closely placed series; base feebly and broadly emarginate, subequal to the pronotal base; humeri minutely dentiform.

*Parapleura* rather distinctly and densely punctate.

*Sterna* more or less obsoletely sculptured.

*Abdomen* smooth, apical half of fifth segment finely and densely punctured; surface more or less obsoletely and irregularly rugose.

*Legs* rather feebly sculptured, except the distal half of the tibiae, which are densely muricato-punctate. Tarsi dissimilar in the sexes. Femora mutic.

*Male.*—Rather more elongate, less convex and a little narrower. Abdomen slightly oblique to the sterna, feebly flattened. First two joints of the anterior tarsi clothed beneath with pads of rather coarse golden

brown setiform hairs, which are graduated from base to apex; similar setiform hairs form apico-marginal tufts on the other joints, divided at middle, and leave the plantar grooves open; on the middle tarsi the plantar grooves are open, the joints are fringed beneath with golden brown setiform hairs.

*Female.*—Stouter, body rather more inflated and broader. Abdomen horizontal, rather evenly and not strongly convex. Plantar grooves open on all of the tarsi; joints with apico-marginal tufts of golden brown setiform hairs.

*Measurements.*—Length (Types), 28–26 mm.; width, 11 mm.

Holotype, male, in the collection of the California Academy of Sciences; paratypes in the Academy's and the author's collection. Three specimens studied.

*Type locality* and *habitat.*—Sierra Laguna, Lower California; collected by J. R. Slevin on August 15, 1919.

The form and habitus are exactly alike in *mutilata* and *lucae* Lec. It has the appearance of being an edentate and smooth *lucae*. The anterior femora are entirely mutic. As nothing is known regarding the status of similar forms it is best to consider it a species rather than a race of *lucae*.

The following are the genital characters:

*Male.*—Edeagophore oblong-ovate, moderate in size, about two and a half times longer than wide and feebly arched.

*Basale* not strongly convex, less so on the dorsum, with an impressed median groove; sides parallel, less than moderately and broadly arcuate, apex bilobed, median emargination arcuately rounded at bottom.

*Apicale* triangular, apex short and rather obtusely rounded; sides broadly arcuate, but briefly sinuate at sides of apex; surface convex with an impressed median groove extending from apex to base; base sinuate laterally, adapted to the apical lobes of the basale, obtusely lobed at middle.

*Female.*—Genital segment subtriangulo-parabolic, moderate in size and setose.

*Valvula.*—Dorsal plate oblong, rather narrow, sides feebly arcuate, with apex rounded; surface feebly concave, finely and very sparsely punctate, each puncture with a very small seta. Apex short, stout, rather broadly rounded at tip, somewhat divergent with that of the opposite valve. Appendage situated at and almost beneath the apical margin of the dorsal plate, very small and not easily seen within the fossa. Fossa moderate in size, adjacent surface of apex with many short hairs. Superior pudendal membrane attaining the middle of the

dorsal plate, broadly and rather parabolically exposed, longitudinally rugulose.

*Valvular* membranes visible between the apices and finely setose. Ventro-lateral surfaces evenly convex, not noticeably swollen; submarginal groove moderate and continuous with the concavity on the under surface of the apex; surface with very fine and very sparsely placed punctures and setae. Internal margins of the valves contiguous apically and briefly so at base. Genital fissure ample and fusiform, exposing the inferior pudendal membrane.

*Eleodes corvina*, new species.—*Form* elongate subovate, about twice as long as wide, moderately convex. *Color* deep black, rather shining, head and pronotum somewhat duller.

*Head* short, wider than long, feebly convex, frontal suture more or less distinct and moderately impressed; surface closely and evenly punctured, punctures almost coarse and more or less coalescent. Antennae moderate in length, reaching to the base of the pronotum, gradually and feebly incrassate; third joint equal to the fourth and fifth taken together; fifth, sixth and seventh subequal in length and very little longer than wide; eighth subtriangular, ninth triangulo-oval, tenth transversely oval; eleventh short ovate, about as long as wide, rather obliquely truncate at tip.

*Pronotum* moderately transverse, widest at middle, apex almost truncate, apical angles distinct, not in the least prominent and obtuse; sides rather strongly and broadly arcuate, almost straight posteriorly and convergent to the base, marginal bead fine; base slightly arcuate to subtruncate, obsoletely beaded; basal angles obtuse and deflexed with the discal surface; disk rather strongly convex, most strongly so laterally and at the basal angles, where it is quite declivous; densely, somewhat irregularly punctate, punctures a little larger than those of the head, slightly coarse, rather smaller and sparsely placed centrally, becoming more or less crowded and coalescent laterally.

*Propleura* full and convex, more or less but not strongly muricately punctato-rugose.

*Elytra* elongately ovate to oval, moderately convex, obliquely and rather rapidly declivous posteriorly, apex rather narrowly rounded; humeri distinct, not in the least prominent; base feebly emarginate and a little wider than the contiguous pronotal base; disk distinctly and strongly sculptured, rather coarsely punctato-rugose centrally along the suture, becoming rugoso-tuberculate laterally and on the apical declivity.

*Parapleura* and *sterna* rather densely and not coarsely punctate.

*Abdomen* rather densely punctate and more or less rugose.

*Legs* somewhat short and moderately stout, rather densely sculptured. Tarsi similar in the sexes, plantar grooves open throughout.

*Male.*—Narrower and more elongate ovate, somewhat less convex. Abdomen slightly oblique to the sterna and noticeably flattened; tibial spurs short.

*Female.*—Broader, more elongate oval, elytra more convex; abdomen horizontal and more convex.

*Measurements.*—Length (Types), 14–15 mm.; width, 5–6 mm.

Holotype, male, and allotype, female, in my own collection. Paratypes in that of Mr. Ralph Hopping.

*Type locality.*—Dry Lake, Klamath National Forest. Collected on September 17, 1912, by Mr. Ralph Hopping.

The elytral sculpturing in *corvina* is almost like that observed in *Eleodes cuneaticollis* Casey, but more coarsely punctate centrally and more distinctly tuberculate laterally. *Papillosa* Blais., a closely related congeneric species, is larger and more elongate, the elytral tubercles are rounded, distinct, shining at their summits and not intermixed with rugae; in *granulata* Lec. the surface is more opaque and the elytral tubercles are rather elongate, while in the variety *obtusa* Lec. the sculpturing is more eroded and dull, with the body form more like that of *corvina,* but in the latter the elytral sculpturing is distinctly punctato-tuberculato-rugose. The sculpturing of *vandykei* Blais. is much less developed and more of the muricato-punctate type, while in its race *parvula* Blais. the size is smaller, the pronotum more quadrate, and the elytral tubercles are evident, variable in number and more or less muricato-tuberculate.

*Eleodes acutangula,* new species.—*Form* oblong-oval and moderately convex as in *scabricula* Lec. *Color* black and quite opaque.

*Head* rather less than one-half as wide as the pronotum, feebly convex with broad and very shallow impressions within the antennal convexities; rather coarsely and irregularly punctate. Antennae about attaining the pronotal base, outer joints feebly compressed and slightly wider.

*Pronotum* distinctly opaque, widest at middle and transverse; apex broadly, evenly and moderately emarginate in circular arc; sides quite evenly and broadly arcuate, straighter posteriorly to base, margin more or less feebly reflexed; apical angles quite prominent anteriorly and rather acute; basal angles obtuse, distinct and slightly prominent laterally on account of the basal bead.

*Elytra* oval, opaque, sculptured as in *consobrina* Lec., but somewhat coarser, that is, rather coarsely punctate centrally and granulato-

muricate laterally and on the apical declivity; humeri rather distinct; disk moderately convex to somewhat flattened at times.

Otherwise as in *scabricula*.

*Male*.—Elongate oval and narrower.

*Female*.—More robust.

*Measurements*.—Length (Types), 20–21 mm.; width, 9–10 mm.

Holotype, male, and allotype, female, in my own collection. Paratypes in that of Mr. Ralph Hopping.

*Type locality*.—Cannel Meadow, Kern County, California; collected June 11, 1913, by Mr. Ralph Hopping.

*Habitat*.—Cannel Meadow and Breckenridge Mountain, Kern County, California. A paratype from the latter locality was taken at an altitude of 6000 feet. Number of specimens studied, nine.

*Acutangula* differs from *scabricula* in its distinct and quite strong apical pronotal angles, coarser sculpturing and more opaque lustre. In *scabricula* the apical angles are distinctly obtuse and rather narrowly rounded, basal angles obtuse and not in the least prominent. In *acutangula* the basal angles are distinct and obtuse, and rendered slightly prominent by the basal bead alone.

A single specimen taken by Mr. J. R. Slevin, at Glenbrook, Nevada, on August 25, 1913, is referred to this species.

*Tenebrio tenebroides* Beauv.—This phase or race of *T. picipes* Herbst., according to the Leng Catalogue of the Coleoptera of North America, has a wide range of distribution, being particularly mentioned as occurring in Southern California, Newfoundland and Florida. In all probability it is only one of the modifications of the cosmopolitan *picipes*.

Some thirty years ago I took a single specimen from beneath the bark of a tree on top of the Bolcan Mountain, near Julian, San Diego County, California. This region was isolated as far as commerce was concerned, but not far distant from the Santa Isabel Indian Reservation. At any rate the specimen remained a unique in my collection until quite recently, when Mr. F. W. Nunenmacher found another in Shasta County, and meanwhile Mr. Ralph Hopping collected another at Fort Tejon, California. All these localities were away from commercial warehouses. These specimens differ from the eastern examples in being more *distinctly punctured* on the upper surface. In the more abundant specimens of *picipes* Herbst. the punctuation of the head, pronotum and elytral intervals is scarcely distinct. In both forms the punctures of the elytral striae are distinct. The manner of dispersion of cosmopolitan species is an interesting problem.

*Helops simulator*, new species.—*Form* elongate-ovate, alate; wings about as long as the elytra; densely punctate above. Color black.

*Head* about as long as wide, transversely impressed on the epistoma; front scarcely convex, densely punctate, punctures moderate in size. Antennae moderately long and slender, outer joints compressed.

*Pronotum* subquadrate, slightly wider than long; apex truncate; base subtruncate, very feebly sinuate laterally; sides moderately arcuate in anterior two-thirds, thence slightly convergent to base and more or less sinuate to parallel before the angles; disk moderately convex, declivous at the apical angles and slightly flattened about the basal angles, densely punctate, punctures moderate and just a little larger than those on the head; apical angles narrowly rounded; basal angles rectangular.

*Propleura* densely punctate.

*Elytra* widest at the posterior third, a little more than one-half longer than wide; humeri small; sides diverging and feebly arcuate to apical half, thence more strongly and broadly arcuate to apex, the latter obtusely rounded; disk rather strongly convex posteriorly, less so anteriorly, evenly and arcuately declivous posteriorly, densely ruguloso-punctate, striate, striae fine and broken up into short lines by the rugulae, sometimes scarcely evident.

*Male.*—Form somewhat narrower. Anterior tarsi moderately dilated.

*Measurements.*—Length, 12–20 mm.; width, 5.2–7.75 mm.

*Habitat.*—Under bark.

Holotype, female, and allotype, male, in my own collection. Paratypes in my own and Mr. F. W. Nunenmacher's collection.

*Type locality.*—Male taken at Sisson, and the female at Shasta Retreat, Siskiyou County, California.

*Distribution.*—California (Humboldt County: Green Point Ranch, elevation 1500 feet, June; Siskiyou County: Sisson, July; Shasta Retreat, elevation 2416 feet, July; Shasta County, May).

*Remarks.*—*Simulator* appears to be absolutely distinct from *opacus* Lec. The latter is apterous and the pronotum is much more strongly convex. They may or may not inhabit the same territory. *Opacus* is taken quite commonly in Calaveras County. As Horn states, the "winged species has the elytra depressed, more elongate and less rounded on the sides; the thorax is also less convex, rather broader and with less rounded sides." These remarks apply to *simulator*, which Dr. Horn considered a form of *opacus*.

*Helops regulus,* new species.—*Form* elongate oval, slightly narrowed anteriorly, convex. Color nigro-piceous, scarcely submetallic, shining; legs and antennae more or less rufo-piceous; beneath rather rufo-piceous.

*Head* convex, more or less deeply and transversely impressed behind the frontal suture, rather coarsely, strongly and moderately densely punc-

tate, punctures rounded, scarcely coalescent. Antennae moderately short and somewhat stout, reaching a little beyond the base of the pronotum.

*Pronotum* nearly as long as wide, not noticeably transverse, apparently widest at the middle; sides rather moderately arcuate, finely beaded; apex and base subtruncate, not strongly beaded; apex a little narrower than base; apical angles subrectangular; basal angles obtuse and somewhat rounded; disk moderately strongly convex from side to side, quite narrowly explanate and impressed within the bead; punctate, punctures more or less irregularly placed, moderately coarse, partly somewhat slightly elongate at the sides.

*Elytra* oval, about three-sixths longer than wide; sides evenly arcuate and subparallel, obtusely rounded at apex; base truncate, humeri small and slightly prominent anteriorly and distinct; disk rather evenly convex, striae of small punctures which are slightly irregularly spaced and feebly impressed; intervals sometimes slightly convex, finely and sparsely punctulate, not tuberculate nor rugulose on the apical declivity.

*Propleura* finely and more or less irregularly longitudinally rugulose.

*Abdomen* somewhat rugulose and rather more thickly punctate on the first two than on the succeeding segments.

*Tarsi* clothed beneath with rather soft yellow hairs.

*Male.*—Rather narrower, antennae slightly stouter.

*Female.*—Somewhat broader, antennae somewhat more slender.

*Measurements.*—Female holotype: Length, 5.8 mm.; width, 2.2 mm.

The accompanying male allotype measures 7.5 mm. in length; the elytra are separated and the wings are rudimentary.

The types are in my own collection. Collected by Mr. W. M. Mann, on May 15, 1904. About twenty specimens in various collections have been studied.

*Type locality.*—Wawawai, State of Washington.

*Regulus* was first referred to *pernitens* Lec. with considerable doubt. It at first sight resembles *aereus* Germ. in general facies, from which it differs in the narrower elytra and different punctuation of the head and pronotum. In *pernitens* the pronotum is distinctly transverse, antennae longer and more slender, elytra broader, sides of the pronotum distinctly explanate with margin reflexed. In both species the mentum is longitudinally carinate at middle with the sides opaque, carina smooth and shining. In *regulus* the pronotum is rather more punctate than rugulose, the reverse in *pernitens*. The propleura in *aereus* is sculptured with rather regular, strong, parallel, longitudinal rugae, some of which divide.

*Helops obtusangula*, new species.—*Form* elongate ovate, subparallel, moderately depressed. Color brownish to piceous, not metallic; legs and under surface more or less rufo-piceous. Apterous.

*Head* subquadrate, front scarcely convex between the eyes, flattened toward the epistoma, sides of front moderately prominent; feebly and transversely constricted behind the eyes; densely, not coarsely punctate, punctures more or less slightly coalescent. Eyes slightly prominent. Antennae slender, outer joints slightly compressed, last three just a little wider, eleventh oval.

*Pronotum* subquadrate, about a fourth wider than long; apex almost truncate, somewhat feebly arcuate centrally; apical angles obtuse; sides feebly arcuate from apex to base, most strongly so anteriorly, less so posteriorly and just the least converging, marginal bead not strong or prominent; base almost truncate; basal angles obtuse and narrowly rounded, scarcely distinct; disk not strongly convex, most so anteriorly and centrally at apex, there rather strongly declivous laterally, vaguely and transversely impressed in front of base, surface very slightly flattened in lateral fourths, densely punctate, punctures small, more or less coalescent longitudinally, intervals not conspicuous.

*Propleura* distinctly and not coarsely longitudinally rugulose; rugulae uniting to a greater or less extent, with large, shallow and scarcely distinct punctures in the broad sulci between.

*Elytra* elongate oval, a little more than twice as long as wide, moderately evenly convex from side to side, a little wider than the pronotum, humeri obtusely rounded, base transverse; surface finely striate, striae not noticeably punctate, intervals finely, irregularly and somewhat sparsely punctate, feebly convex especially on apical declivity, there with feeble, small tuberculiform eminences; sides parallel, feebly arcuate, apex somewhat ogival and rather narrowly rounded.

*Abdomen* shining, rather evenly and not densely nor coarsely punctate. Legs rather short.

*Male.*—Narrower. Antennae elongate, joints eight to eleven inclusive at least twice as long as wide, not incrassate, scarcely compressed. Anterior tarsi feebly dilated, and with the middle tarsi quite densely clothed beneath with yellow hairs.

*Female.*—Somewhat broader. Antennae shorter, outer four joints distinctly broader, not twice as long as wide, ninth and tenth subtriangular, slightly compressed. Anterior tarsi very slightly dilated. All the tarsi clothed beneath with yellow hairs, denser on the anterior and middle tarsi.

*Measurements.*—Length (Types), 10.5–8 mm.; width, 3.5–2.6 mm.

Holotype, female, larger sex, in the collection of the California Academy of Sciences. Allotype, male, and paratypes in the collection of the author.

Holotype collected by Mr. Geo. R. Wilson; allotype and paratypes by Dr. E. C. Van Dyke.

*Type locality.*—Corona, California (Holotype); Los Angeles, California (Allotype).

*Obtusangula* has been labeled as *angustus* Lec. in my collection for many years. An examination of my series shows it to be wingless and the propleura distinctly but not strongly rugulose, punctures not evident.

Horn states that *angustus* is winged and that the propleura are coarsely punctate.

*Obtusangula* is related to *stenotrichoides* Blais., similar in form, but less elongate, less robust, and less convex, integuments thinner and the small tubercles of the lateral and apical intervals of the elytra are less evident, besides, the basal angles of the pronotum are obtuse and more or less slightly rounded.

In *stenotrichoides* the basal angles are distinct, propleura punctato-rugulose, punctures distinct and shallow on the coxal convexities; outer joints of the antennae slightly compressed in the male and twice as long as wide; antennae more elongate in the female than in the same sex of *obtusangula*; with joints six, seven and eight rather more elongate. In *strigicollis* Horn the form is narrower, elytra scarcely wider than the pronotum, the latter is distinctly longitudinally strigose, antennae heavier, propleura distinctly punctate. *Strigicollis* and *obtusangula* were taken at the same time at Corona, California, by Mr. Wilson.

*Attenuatus* belongs to the same group of species. My only specimen referred to this species was collected by Mr. Nunenmacher at Goldfield, Nevada. The form is almost subcylindrical, pronotum almost discretely and rather sparsely punctate, antennae with joints four to eleven subequal, propleura coarsely punctate, each puncture with a small yellow hair. I can not agree with Horn in considering that *attenuatus* should be associated with *bachei* Lec. It is very desirable to study the genitalia of the different species, but the scarcity of specimens forbids any dissection at the present time.

The above species, as I view them, may be separated as follows:

Body winged ..... *augustus* Lec.
Body wingless ..... 1
1. Pronotum distinctly strigose ..... *strigicollis* Horn.
–. Pronotum distinctly punctate ..... 2
2. Body distinctly subcylindrical ..... *attenuatus* Lec.
–. Body more or less depressed ..... 3
3. Antennae elongate in both sexes, slightly longer in the male; basal angles of the pronotum distinct ..... *stenotrichoides* Blais.
–. Antennae elongate in the male, distinctly shorter in the female; basal angles obtuse and slightly rounded ..... *obtusangula*, n. sp.

In the above species the color is brownish to piceous, legs more or less rufous with the abdomen darker rufo-piceous.

## ADDENDUM

Mr. Ralph Hopping, of the Canadian Forestry Service, has very recently submitted to me a species of *Listrus*, collected at Vernon, B. C. It has proved to be an undescribed species to which I have given the name *provincialis*, n. sp. The description will in all probability appear in the *Canadian Entomologist* in the near future. The types will be placed in the National Collection at Ottawa. *Provincialis* should follow *difficilis* Lec. in the synoptical arrangement given above.

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# THE FISH FAUNA OF THE CALIFORNIA TERTIARY

BY
DAVID STARR JORDAN
Chancellor Emeritus

STANFORD UNIVERSITY, CALIFORNIA
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# THE FISH FAUNA OF THE CALIFORNIA TERTIARY

## Introduction

The purpose of this paper is to make old bones live again. To this end I have undertaken the restoration, so far as may be, of the bony fishes known to inhabit the shore waters of California in the Tertiary Age ,most of those known being from the Monterey period of the middle Miocene.

The study of these fishes as found in the deposits at Lompoc, and in the region about Los Angeles, has given us a fair idea of the fauna of the period, perhaps 2,000,000 years ago, when the rocks of the middle Miocene known as the Monterey group were deposited.

Only the bony fishes are considered in the present paper. I have nothing to add to the accounts of the sharks I have elsewhere published.[1]

The study of the Miocene fishes of California shows certain facts very clearly.

1. The present fauna of California is derived from that of the Miocene period with a certain admixture from the north and from Japan. In the Miocene fauna, so far as known then, are no types likely to have come over from Japan.

2. The Miocene fauna is transitional, in having its roots in the Eocene or Cretaceous. But no fishes of either of these periods have been found in Pacific Coast deposits either in America or Asia.

3. The Tertiary fauna of California is nearly all included in families still extant on the coast. All of the species are distinct from their living allies, and most of them must be placed in different genera.

4. The most striking difference which appears thus far is that we have found no trace among the fossils of the viviparous surf-fish (Embiotocidæ) which form so conspicuous a part of the existing fauna and which should abound in just the conditions in which fossils have been preserved. As two genera (Ditrema, Neoditrema) representing different sections of this family are found in Japan, it is possible that the California surf-fishes are of Asiatic origin and have crossed to California in relatively recent times. Among the fossil fishes actually known we find none which suggests any affinity with Asiatic forms. Most of them are distinctly characteristic of California, a few only belonging to types now wanting in that region, but represented in the Gulf of Mexico, and in one or two cases in the Mediterranean. In Miocene times, the present Isthmus of Panama was an open channel.

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[1] "The Fossil Fishes of California with Supplementary Notes on Other Species of Extinct Fishes," *University of California Publications*, Geology, **5**, 95-144, 1907.

Jordan and Beal, "Supplementary Notes on Fossil Sharks," *ibid.*, **7**, 1913.

Besides the surf-fishes there are some other forms rare or missing, which one might have expected to find. Gobies are very scarce, although species are now abundant in all shallow waters along the coast. There are no anchovies, sardines, or true herring, the numerous herring-like forms being all of rare or extinct types. We find no blennies, which is less strange, as these fishes mostly frequent the rocks. There are also no Labroid fishes, forms which now abound in the kelp banks outside the bays. There are no COTTIDÆ or sculpins, a group very abundant in the California fauna of today, but which may have invaded the region later from the north, the center of abundance for the group being in the North Pacific.

5. No species, either distinctly tropical or distinctly subarctic appear among the Tertiary fishes of southern California. We must, therefore, conclude that the Miocene temperature differed little from that which obtains at present.

6. It is evident from the absence, partial or complete, of silt or other rain-washed material in the deposits containing fishes, that the climate was arid. In the Lompoc deposits of pure diatoms, there is no sedimentary material whatever.

7. The localities in southern California in which fossil bony fishes have been found are of two categories:

(a) Shallow inlets within a group of small islands scattered about in the region now comprised in the counties of Los Angeles and Orange. The deposits in these little bays are mixed diatoms and fine clay, and the individuals are all either of species of small size or else the young of larger forms. In a few places, individuals are found in clay or even very hard sandstone, more rarely in pure diatoms.

It is a curious fact that the species found about Los Angeles are, with the possible exception of two small fishes, perhaps not correctly identified (LYGISMA, QUÆSITA), all different from those taken in the diatom beds at Lompoc. As to this we may remember that the Miocene period was a very long time, and the Lompoc deposits lie unconformably over the rocks of the Monterey epoch.

(b) The deposits at Lompoc of pure diatoms unmixed with sand or clay, rarely showing organisms other than fishes. Here occur multitudes of fishes, a few birds, petrels, and waders, gannet and snipe, and an occasional porpoise, PHOCÆNA OCCIDUA(?). In these deposits we find no Crustaceans and no Echinoderms. There are a few Annelids., in one place a small clay concretion bored full of holes by a Pholadid shell, and in another place a single shell of some species of ARCA. With the diatoms are occasionally microscopic rhizopods, and spicules of sponges.

The Lompoc deposit, already described by Jordan and Gilbert, fills what was once a small, narrow-mouthed or bottle-shaped inlet on the north side of the Sierra Santa Ynez, the backbone of Santa Barbara County.

Since these mountains rose from the sea, this little bay of Lompoc became filled with diatoms in incredible numbers, to the depth of 1400 feet. A little stream having eroded one side and large cuttings having been made for commercial purposes, we may now see a section of the whole mass from top to bottom. I have elsewhere [2] shown that a species of herring (XYNE GREX) had at one time gathered in such numbers as to cover the whole floor of the bay to the exclusion of all other kinds of fish. This was at a level of 950 feet above the sandstone and shales on which the diatom deposits rest. Among these millions on millions of herring, no young specimens were found, all of them ranging from 6 inches to 8 inches in length, and not a foot in the whole four square miles, so far as yet exposed, has less than eight or ten of these fishes. In a single place, much higher up and all by themselves, there is a deposit of many young herring, each two to three inches long.

Dr. Edward C. Franklin figures, on data which I have furnished, that there must have been some 1200 millions of these herring and that the number of diatoms in the whole bay might be represented by the unit 1 followed by at least 30 ciphers.

Among the herring we find no other kinds of fish whatever, and the question of what caused the sudden death of this vast multitude and their sudden burial in clouds of white diatoms, constitutes a problem very difficult to solve. The only clues to the solution are offered by Dr. Albert Mann, in a letter which I append to the present paper.

Higher up in the diatom deposits occur the remains of numbers of predatory fishes, which seem to have come to the bay in search of the herring. These I have described in two papers [3] written in collaboration with Dr. James Zaccheus Gilbert, of the Los Angeles High School, who has been very active in hunting these relics of an ancient life. Only a single young fish (EMMACHÆRE) of a predatory type has been found in the Lompoc deposits.

In the present memoir I offer restorations of nearly all the bony fishes, predatory or otherwise, known from the California Tertiary. These are the work of William Saxton Atkinson, who, for the last twenty years, has acted as scientific illustrator at Stanford University.

It may be noticed that no fossil fish is ever quite complete—one part or another is wanting. Ordinarily, the head is the least satisfactory portion. While the bones of the skeleton are picked clean by small organisms

[2] "A Miocene Catastrophe," *Natural History, American Museum,* **20**, 18, New York, 1920.

[3] David Starr Jordan and James Zaccheus Gilbert, "Fossil Fishes of Southern California," *Stanford University Publications,* University Series, Sept., 1919. David Starr Jordan and James Zaccheus Gilbert, "Fossil Fishes of Diatom Beds of Lompoc," *Stanford University Publications,* University Series, February, 1920.

in the sea, the soft mass of the brain decays, and in rotting it disintegrates the bones which lie around it. Although in most fishes the bones of the head are especially firm and hard, they are very seldom preserved in fossil form, and the student is obliged to give his attention to the skeleton and to the neural and hæmal structures which spring from it. The position and structure of the fins can be made out from these bones, but the rays are usually broken. Hence, there are always elements of doubt as to the accuracy and completeness of any restoration. The elements of doubt in connection with Mr. Atkinson's admirable plates, I shall indicate in the course of this paper.

No traces of sharks are found in the diatom deposits, although multitudes of sharks' teeth are found in the rocks which in other regions overlie diatom masses. As it is thought there is some possibility that the great oil deposits of southern California come from these masses of diatoms, it is evident that the abundance of sharks' teeth is an indication of oil. This is especially true in Kern County, from which district numerous teeth of sharks have been described by Professor Agassiz in early days, and later by the present writer. It is possible that the oil escapes to the air in regions where, as in Lompoc, the diatom deposits are exposed. Where deposits are covered by later layers of sand and shale, the oil may be preserved to our time.

# Order ISOSPONDYLI

## Family I. GANOLYTIDÆ

### 1. Ganolytes cameo Jordan

Plate 15.

GANOLYTES CAMEO Jordan, "Fossil Fishes S. Cal," **6**, pl. II, fig. 3, IV, figs. 1, 2. (Brown's Cañon, Soledad Pass, Puente Valley in deposits of the Soledad, lowest Miocene or Oligocene formation.

This is a big robust herring-like fish, two to three feet in length, with large, thick, enameled scales, which on one side are highly ornamental. No single example is complete, and I have no clear explanation of the difference in appearance between the scales in place and the highly sculptured, cameo-like examples found scattered about the skeletons of the fishes themselves. In our restoration, we have drawn the head and fins after related species. Whether GANOLYTES possessed ventral scutes, I do not know but think it unlikely. The forms of individual scales are well represented in our plate II in "Fossil Fishes of Southern California."

I am forced to regard GANOLYTES as the type of a family distinct alike from the living CLUPEIDÆ and the extinct PHOLIDOPHORIDÆ and LEPTOLEPIDÆ. ETRINGUS and GANOËSSUS are no doubt related forms.

### 2. Etringus scintillans Jordan.

ETRINGUS SCINTILLANS Jordan, "Fossil Fishes of California," *Univ. of Cal. Publ.*, Geology, **5**, 121, figs. 17, 20, 1907. (Brown's Cañon, Soledad Pass, in rocks of Oligocene age.) Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 5, pls. I, III, fig. 1, 1919.

This herring-like fish with large, thin, smooth, enameled scales seems to be an ally of GANOLYTES, with which it was at first confused. The vertebræ in both genera are 35 to 37, those in the related GANOËSSUS about 42. In our restoration (plate 3, above), the elements of uncertainty are indicated by dotted lines.

### 3. Ganoëssus clepsydra Jordan and Gilbert.

Plate 16.

GANOLYTES CLEPSYDRA Jordan and Gilbert, "Fossil Fishes S. Cal.," 23, pl. XI, fig. 1, (El Modena.)

GANOËSSUS CLEPSYDRA Jordan, "Genera of Fishes," **4**, 1920, same type.

This large herring-like fish, with coarse, enameled scales, seems to be related to GANOLYTES, but the scales are much thinner and lack sculpture. Vertebræ hourglass-shaped, 42 in number. In the type, the middle part

of the body is well shown, but the short, deep head is crushed, the caudal is gone, and the anal mostly obliterated. The ventral is opposite the front of the dorsal, which was probably longer in life than our restoration shows, while the anal may have been shorter.

I do not know whether GANOËSSUS had, in life, ventral scutes: I have assumed that these are lacking as seems to be the case in GANOLYTES and ETRINGUS. If these are present in ETRINGUS or GANOËSSUS, these genera would be referred to CLUPEIDÆ. As matters are we are forced to regard all three as primitive clupeoids, harking back to the Cretaceous PHOLIDOPHORIDÆ. As this paper is in press, Dr. Gilbert has received from the Miocene of Covina, near Los Angeles, a second species of GANOESSUS with more elongate vertebræ and similar enameled scales. Scales and fragments of this new species we find abundant in the beds at Covina, Alhambra, and Bairdstown.

## Family II. **ELOPIDÆ**

### 4. **Ectasis proriger** Jordan and Gilbert.

Plate 17(*a*).

ECTASIS PRORIGER Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 62, pl. XXII. (Pliocene of Los Angeles.)

In the type, the head is very obscure, the lower jaw seemingly projecting and both jaws apparently with small teeth; the caudal, pectorals, and ventrals are entirely obliterated, and the number of rays in dorsal and anal, as well as the form of the fin, can not be accurately made out. As, however, the fish seems closely related to the living genus ELOPS, we have restored the missing characters in accordance with that genus. The number of vertebræ is, however, larger in ELOPS, $43 + 29 = 72$. In ECTASIS we find $38 + 22 = 60$, but a few of the posterior vertebræ may be lost with the caudal fin. The lower jaw seems heavier in ECTASIS than in ELOPS, but the two genera appear very closely allied.

## Family III. **CLUPEIDÆ**

### 5. **Xyne grex** Jordan and Gilbert.

Plate 18.

XYNE GREX Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 25, pl. IX, fig. 1; pl. X, fig. 2; pl. XI, figs. 2, 3. (Lompoc; Bairdstown.) Jordan, "A Miocene Catastrophe," *Natural History,* New York, **20**, 18, 1920. (Lompoc.) Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 9, pls. I, II, III. (Lompoc.)

As stated in our paper on the fishes of Lompoc, the inordinate number of individuals of this herring found at Lompoc in a single horizon is one of the most remarkable incidents in paleontology, a stratum for four square miles being covered with them wherever it has been exposed.

The genus is characterized by the general form of the existing herring, CLUPEA, but the ventral scutes are much longer and sharper.

I find no dorsal scutes and the vertebræ are 45 in number. The bones of the head seem to have been enameled. The ventral fin is opposite the front of the dorsal. Whether XYNE had an adipose eyelid I do not know.

*Young of Xyne grex.*

Three slabs (419, 58, 59), each covered with small fishes (65, 60, and 40 in number, respectively), were obtained at Lompoc. Each fish is 3 to 3½ inches long. These are much smaller than the examples of XYNE GREX which occur in masses on a much lower horizon, and scattered about higher up. From XYNE GREX I can distinguish these examples by the smaller size and by the absence of ribs, only fine traces of these structures showing in the larger examples. The few in which the vertebræ can be counted show them to be 43 to 45 in number. In every unquestioned example of XYNE GREX, 6 to 8 inches in total length, the ribs are plainly in evidence. Except the caudal and one or two traces of dorsal, these young Lompoc examples have no fins preserved. These little fishes look much like those on a slab from El Modena (XVII) provisionally referred by us in "Fossil Fishes of Southern California" (p. 32, pl. VIII, fig. 3) to QUÆSITA QUISQUILIA. These latter are still smaller and more slender, with no trace of ribs, though the posterior neurals and hæmals are well developed. In them I count, however, but 40 vertebræ (38 in the type of Q. QUISQUILIA). In the three type specimens of the known species of QUÆSITA (Q. QUISQUILIA, Q. FRAGILIS, and Q. ALHAMBRÆ) I find not the slightest trace of ribs. The Lompoc examples are probably the young of XYNE GREX, although the fact that but two or three out of 150 show even traces of ribs makes me hesitate.

### 6. **Xyne fitgeri** Jordan and Gilbert.

XYNE FITGERI Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 10, pl. V. (Lompoc.)

Among the herring in the "XYNE" horizon, in which millions of individuals lie at the same level, I find but a single species. But among the scattered individuals in the upper beds, there are some of larger size, with heavier head, larger mouth, and usually the backbone more or less arched, as if its supports were more fragile. The ribs are longer than in XYNE GREX, but shorter than in XYRINIUS ELMODENÆ. The ventral scutes are moderate, much as in XYNE GREX, and I find no indication in any specimen of either species of XYNE of the presence of dorsal scutes.

It is possible that XYNE FITGERI is an adult form of XYNE GREX, but at present the evidence favors the distinction of the two species. The vertebræ in both number 44 or 45.

### 7. Xyrinius elmodenæ (Jordan and Gilbert).

Plate 19.

ELLIMMA ELMODENÆ Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 26, pl. XII, fig. 1. (El Modena.)

The genus ELLIMMA was framed for two species of short-bodied, double-armored herring (E. BRANNERI, type) from the Eocene of Brazil. The present species has much in common with ELLIMMA so far as general appearance is concerned, but it has 44 instead of 33 vertebræ, and the ventral region is much less gibbous. The caudal portion is broken in the type. This part has been restored from XYRINIUS HOUSHI, which differs, so far as our material shows, only in the fewer vertebræ and perhaps in the smaller ventrals.

### 8. Xyrinius barbaræ (Jordan and Gilbert).

ELLIMMA BARBARÆ Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 27, pl. IX, fig. 3. (Carpinteria, Santa Barbara County.)

This species is very close to X. ELMODENÆ, but if correctly interpreted, it has a shorter head, and larger body cavity. The statement that the vertebræ are fewer is doubtful. There were probably 44 or 45 in each. and it may be that the two forms are not really distinct.

### 9. Xyrinius houshi Jordan and Gilbert.

XYRINIUS HOUSHI Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 50, pl. XXXI, fig. 2. (Miocene Sandstone at Los Angeles.)

This species is known from a very small example with the front of the head and tips of the caudal broken. It was at first mistaken by us for a Labroid fish, from the apparent form of the head, but the abdominal ventrals are clearly shown under the glass, and we see no character, except the smaller number of vertebræ by which it can be separated from the group to which the species called ELLIMMA ELMODENÆ belongs. We find 33 or 34 vertebræ instead of 44. In this regard X. HOUSHI agree fairly with the two species of ELLIMMA from Brazil. But whether any of the California species had dorsal scutes like the Brazilian ones we do not know. Their absence may for the present define the genus XYRINIUS.

In view of various uncertainties and especially the fact that the generic name XYRINIUS has been already given I may provisionally use that name for these California Miocene forms. In all these species the ribs are very long and regularly curved.

The erroneous statement in our original account of X. HOUSHI, that the "ventrals are thoracic," arose from the fact that the pectoral fins of the other side appear under those of the left side. The ribs are long and well developed, as in X. ELMODENÆ. The front of the head, the scales, and

the fin rays in this species are uncertain, but the form in life must have been about as shown in our restoration of XYRINIUS ELMODENÆ. The only appreciable difference is in the number of vertebræ.

### 10. **Alisea grandis** Jordan and Gilbert.

Plate 27(*b*).

ALISEA GRANDIS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 28, pl. XVII, fig. 3 (San Pedro, in hard, flinty Miocene sandstone.)

This large, shad-like herring is known from a single specimen, which lacks the head and the pectoral region. The caudal fin of another example is also preserved. We have as yet no means of knowing whether either ventral or dorsal scutes were present. The resemblance of the rest of the body to the Eocene genus DIPLOMYSTUS [4] indicates that it was probably one of the double-armored species. The scales are very small for a herring, much smaller, however, than our drawing shows, as the artist has not fully considered the imbrication of scales in life. We know nothing of the head, the pectorals or the ventrals. The very long anal had not far from 33 rays; the number of dorsal rays is uncertain, but there were at least 14; vertebræ about 50; neurals and interneurals long and very slender, as usual in herring; scales small, smooth, estimated by us at 35–200–40, but this is very uncertain, as the scales are scattered and largely detached; caudal fin scaly at base. The large size of the caudal, with the unusual length of its lobes must be distinctive of ALISEA, which is probably an ally of the "double-armored herring" of the Eocene, a group still represented in Brazil and Australia.

### 11. **Quisque gilberti** Jordan.

Plate 20(*b*).

QUISQUE GILBERTI Jordan, "Genera of Fishes," **4**, 571, 1920. (El Modena.)

The type (No. 18) of this species is a small fish about 2¼ inches long, exceptionally well preserved, from diatomaceous shale in Hews Park, El Modena, collected by Delbert Brunton of Fresno, a former student of mine, then science teacher in the high school at Orange.

Head 3⅜ in length to base of caudal; depth at dorsal 4 1/10; eye 3⅕ in head; snout 4. Head large and deep, as deep as body at front of dorsal; no interorbital shelf evident in the large eye, bones of head strong, opercle well developed, preopercle evident, mouth rather large, the lower jaw somewhat projecting; a possible trace of teeth in front of upper jaw; maxillary broad, reaching to beyond middle of eye, a little more than half head; its edge slightly convex; mandible a little longer. Vertebræ 20 (to

[4] Called COPEICHTHYS by Dollo, who regards DIPLOMYSTUS as preoccupied by the earlier DIPLOMYSTES.

22) + 10 = 30 (to 32), slightly longer than deep, strong throughout (last few vertebræ obliterated); neural and hæmal spines and especially ribs well developed; 9 or 10 long, sharp scutes before ventrals and as many behind. Dark markings, probably scutes on median line in front of dorsal; 9 or 10 of these, all much fainter than the ventral scutes; dorsal rays 12; anal 10 or more; pectoral more than 12; ventral about 10. Caudal long, deeply forked, the rays in each lobe 10 or more, the lobes equal, longer than head, nearly 4 in length of body, hypural plate obliterated. Pectoral well developed, half as long as head, inserted very low; ventrals smaller, placed behind front of dorsal; dorsal inserted considerably nearer to snout than base of caudal, about opposite the twelfth vertebra, the rays strong, their height equal to depth of body, the fin covering 5 vertebræ; anal partly obliterated, the interhæmals about 10, these weaker than interneurals. Ribs long, strong, with hair-like processes. No scales preserved.

A second specimen (No. 17) is much larger, 5 inches long and nearly as well preserved. The two agree fully.

A third specimen (No. 19) shows the head and shoulders only of a larger individual. The back shows some scutes apparently like those on the belly but much smaller. This leads us to believe that this is one of the double-armored herrings, and therefore more or less related to the Eocene genera KNIGHTIA and DIPLOMYSTUS.

The genus QUISQUE may be defined by the presence of very strong ventral scutes, and probably dorsal scutes also, in connection with the stout body and head and the small number of vertebræ. I know no other herring having the ventral scutes as highly developed.

## Family IV. **DUSSUMIERIIDÆ.**

### 12. **Quæsita quisquilia** Jordan and Gilbert.

Plate 22(*a*).

QUÆSITA QUISQUILIA Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 31, pl. VIII, fig. 3; pl. X, fig. 2; pl. XVII, fig. 1. (El Modena.)

This little fish is a characteristic representative of the living group of "Round Herrings"; that is, herring having the ventral region convex without median ridge or scutes. It was found abundant in the diatomaceous shales at El Modena.

Compared with related forms, the genus QUÆSITA is slender and elongate, with 34 to 38 vertebræ, the mouth of moderate size and the ventrals inserted under the front of the dorsal. SMITHITES has more vertebræ than QUÆSITA, AZALOIS, a larger mouth, more compressed body, with much weaker vertebræ, especially anteriorly. LYGISMA has the ventral fins inserted farther back, and the vertebral column very tough. No scales are shown in any of our fossils of this family, the size of the anal

fin in Q. QUISQUILIA is uncertain, the rays perhaps fewer than the drawing shows.

Besides the original types from El Modena I have one, apparently the same, from the diatom beds at Lompoc. This is No. 526, 4′ inches long, in fair condition. Head 3⅗ in length to base of caudal, depth about 5½. Body long and slender, the depth rather uniform from head to tail. Eye large, longer than snout, about 3 in head, a little shorter than postorbital part of head. Interocular shelf conspicuous; mouth obscure, apparently short and oblique. Vertebræ small, longer than deep, apparently 37 (35 to 38) in number; neurals and hæmals little developed anteriorly, becoming stronger behind the dorsal fin; interspinals short and weak. Dorsal inserted over ninth vertebra at a point rather nearer tip of snout than base of caudal, the fin higher than long, its rays 16. Ventral inserted slightly behind front of dorsal; pectoral reduced to a trace. Anal longer and lower than dorsal with about 10 rays. Caudal narrow, deeply and equally forked, the lobes 1½ in head. Hypural obscure. This fish is rather more slender than the type of QUÆSITA QUISQUILIA, the dorsal fin a shade nearer the head. Our specimen, however, probably belongs to the same species. QUÆSITA FRAGILIS is also very close, but it is a shorter and deeper fish with the dorsal rather farther back. QUÆSITA ALHAMBRÆ has fewer vertebræ and the dorsal still more posterior.

### 13. **Quæsita fragilis** Jordan and Gilbert.

Plates 14(*b*), 23(*b*).

QUÆSITA FRAGILIS Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 3, no plate. (San Pedro Hills, in Pliocene deposits of Diatoms.)

This handsome species is represented by the type example, which shows well the head and all the fins. The ventral is under the front of the dorsal. There are 38 vertebræ. Nothing is known of the scales.

### 14. **Quæsita alhambræ** Jordan and Gilbert.

QUÆSITA ALHAMBRÆ Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 43, pl. XXVIII. (Alhambra, in Miocene shales.)

This very small fish seems to belong to the genus QUÆSITA, but the vertebræ are fewer, not much above 30 in number, and deeper than long.

### 15. **Smithites elegans** Jordan and Gilbert.

Plate 24(*b*).

SMITHITES ELEGANS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 30, pl. XXIX, fig. 3. (Bairdstown.)

This exquisite little fish seems to resemble the living genus JENKINSIA Jordan and Evermann, of the Gulf of Mexico and Gulf of California.

JENKINSIA STOLIFERA has, however, but 42 vertebræ, whereas in SMITHITES the number mounts to 25 + 32 = 57. The ventrals are inserted under middle of dorsal, not under the anterior rays as in QUÆSITA, nor behind it as in LYGISMA.

In our illustration, the scales, fins, and form of head are taken from related species. The type, otherwise well preserved, lacks the snout and the anal fin.

### 16. **Lygisma tenax** Jordan and Gilbert.

Plate 21(*a*).

LYGISMA TENAX Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 33, pl. VIII, fig. 2; pl. XIV, fig. 1. (El Modena.) Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 12. (Lompoc.)

This genus is an ally of QUÆSITA, being distinguished by the insertion of the ventrals behind the dorsal fin. The ventrals are larger than in QUÆSITA, and the vertebral colum seems much tougher than in any of the other Round Herrings; the strong vertebræ are closely connected in all the four specimens seen, and the backbone much twisted without being broken. A third specimen comes to me from Alhambra through Mr. Hadley. Still another and a fragment of a fifth referred to the same species, though not without doubt, were found in the diatom beds at Lompoc.

The head, scales, form of the dorsal and pectoral and some other traits are restored in accordance with analogies.

### 17. **Rhomurus fulcratus** Jordan.

RHOMURUS FULCRATUS Jordan, "Fossil Fishes S. Cal.," p. 9, pl. IV, figs. 3, 4; pl. V, fig. 1. (Soledad Pass; lower Miocene or Oligocene.)

The relations of this little fish are still obscure. The type, 3 inches long, has an elongate form, 35 vertebræ, no hypural plate, but the last vertebræ unusually strong, with large neurals and hæmals. The short dorsal fin is median, over the ventrals, and the small anal is far behind it. The caudal fin is unusually broad and well forked. No scales are shown in our specimen and the form of the mouth and head is uncertain. The shadowy outline in our figure represents the eye of the left side showing through. The left pectoral appears through distortion under the one of the right side.

While the general characteristics of the fish indicate CLUPEOID or herring-like affinities, we are not sure that it belongs with the DUSSUMIERIIDÆ, although its tail is much like that of LYGISMA.

## Family V. GONOSTOMIDÆ.

### 18. Azalois angelensis Jordan and Gilbert.

Plate 23(*a*).

AZALOIS ANGELENSIS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 32, pl. XV, fig. 2. (Bairdstown.)

This dainty little fish seems to belong in or near the GONOSTOMIDÆ, having much the form of YARRELLA. It has a compressed, elongate body, its depth well sustained backward, and low and rather short vertical fins. I am unable to count the fin-rays, and I do not know whether it had an adipose fin. The scales are uncertain. The head is long, with large mouth and projecting lower jaw; apparently the maxillary enters the upper jaw as usual in GONOSTOMIDÆ. The orbit of the eye is large and nearly median in the head.

The best generic character of AZALOIS is perhaps to be found in the very weak vertebræ, the anterior ones seeming to be barely ossified. There are about 42 vertebræ. There is no trace of ribs, these being no doubt very weak.

In our drawing, many of the traits, as size of scales, form of fins, and the like, are guessed at. It will be necessary to secure additional specimens, besides the original two, before we can be certain as to the affinities of the species.

## Order INIOMI

### Family VI. PARALEPIDÆ.

**19. Trossulus exoletus** Jordan, new genus and species.

Plates 8(*c*), 28(*a*).

Type No. 548, two small fishes delicately preserved on a diatom brick (Celite) from Lompoc. Each is about 3½ inches in length.

Head 3½ in length, depth 3½. Body compressed, apparently quite flat, head large, pointed, the eye large, shorter than snout, 4 in head, mouth very large, the jaws equal, the gape straight, premaxillary narrow, extending well beyond the eye, much as in ENGRAULIS, its edge with small, slender, sharp, even teeth. Maxillary narrow, parallel with it, not entering border of jaw, somewhat dilated at tip. Vertebræ 50 in number, very small, longer than deep, the neurals and hæmals very weak and slender, even on the caudal region, interspinals all obliterated, ribs slender, caudal fin well forked, the lobes nearly as long as head.

Fins almost entirely obliterated, as are also their basal bones. Dorsal fin apparently short and behind middle of body. Faint traces of ventrals before dorsal; anal farther back, but no trace is left of rays or interneurals. No scales preserved. These were probably very thin and transparent.

This little fish, having the margin of the upper jaw formed by the premaxillary, must be one of the INIOMI, and it plainly enters the group called SUDIDÆ (PARALEPIDÆ) by Mr. Regan.

A knowledge of fins and scales is necessary before its genus can be further described. The relatively small eyes, deep, compressed body, sharp snout, and long maxillary, with the posterior dorsal and moderate number of vertebræ, may, for the present, define the genus TROSSULUS.

**20. Lestichthys porteousi** Jordan, new genus and species.

Plates 10(*b*), 22(*b*).

Type No. 220, twenty inches long, the skeleton well preserved, the fins mostly lost, the head incomplete. Head 4⅘ in length, depth 9¼. Vertebræ quadrate, about as deep as long, with a strong median groove, about 56 + 30, 86 in number.

Head apparently low, pointed, with entire bones, jaws rather long, the lower apparently the longer, the maxillary reaching to the front of the large eye; teeth all obliterated, premaxillary seemingly bounding the upper jaw, the maxillary not evident. Neurals and hæmals rather long, subequal, directed evenly upward and backward; ribs rather numerous, slender, relatively long. Anal posterior, inserted under fifty-sixth vertebra, the inter-

hæmals slender and short, set at an oblique angle to the hæmals and only about 8 to 10 in number, the original number of rays probably much larger; the fin mostly obliterated; dorsal fin wholly obliterated; the few short, slender interneurals indicating a posterior insertion of the fin, which was probably small, slightly behind front of anal. Base of caudal only preserved, the fin apparently forked; pectorals obliterated; an apparent trace of ventrals under middle of body, well in front of dorsal and anal, near fifty-fourth vertebra. Scattering scales, rather large, thin, and cycloid, are scattered on and about the body of the fossil.

To all appearances this fish is one of the INIOMI, falling in the family of PARALEPIDÆ (SUDIDÆ of Regan). It seems near the genus PARALEPIS, or perhaps even nearer LESTIDIUM, but a more complete knowledge of its fins will be necessary before it is finally located. The genus LESTICHTHYS, of which it is a type, may be defined by its elongate body, the very large number of vertebræ and the small size of the dorsal fin, the ventrals certainly well before the dorsal. The name indicates its probable affinity with the living LESTIDIUM and LESTIDIOPS.

It is named for Edward J. Porteous, scientific expert of the Celite Company, at Lompoc, whose patient efforts in preserving from time to time the fishes found in the diatom deposits have added so greatly to our knowledge of the Miocene fauna.

In the restoration we are certain as to the general form of the head and body as well as the size of the scales. The insertions of dorsal and anal are definitely shown, but the extension backward of these fins is uncertain.

## Order COLOCEPHALI

### Family VII. MURÆNIDÆ.

**21. Deprandus lestes** Jordan and Gilbert.

Plates 9(*b*), 30(*b*).

DEPRANDUS LESTES Jordan and Gilbert, *Proc. Nat. Hist. Soc. S. Cal.*, 1921. (El Modena.)

The type specimen of this moray (201A) was sent to me from El Modena by Dr. Gilbert, a lower jaw 3¼ inches long. It is slender, straight, curved upward toward the tip, and shows a single row of strong, conical, sharp teeth, somewhat thickened at base, rather close-set, the interval being a little more than half the length of a tooth. The teeth on the middle of the jaw are a little larger than the others, those in the posterior third of the length are more slender, close-set, and apparently in a band, rather than a single row, all the teeth directed more or less backward. There is no trace of lancet-like teeth or of canines. Tip of the lower jaw apparently turned upward. On the fossil are traces of the teeth of the other or right side of the jaw, indicating that the mouth was narrow as well as long.

Another half of a lower jaw (200A) also from El Modena, retained by Dr. Gilbert, is slightly larger, but shows no difference.

Another lower jaw from a much larger fish (No. 571) was sent to me from Alhambra, Los Angeles County, by Mr. E. E. Hadley. This is, in all, about six inches in length. It apparently belonged to a very large moray with long and slender jaws. The posterior part of the jaw has been broken, the teeth obliterated, but on the anterior part is a row of stout, conical, sharp-pointed teeth, all turned forward, the length of each nearly double the interspace which separates it from the next. These teeth are all of about equal length, none of them enlarged or lancet-shaped. In the space of two inches there are about forty teeth. The bones of the jaw are rather strongly striate.

These jaws belong apparently to the same species, which seems to have been a large murænoid eel or moray, allied to the cosmopolitan living genus GYMNOTHORAX (LYCODONTIS), one species of which, G. MORDAX, still abounds on the coast of southern California.

The new genus, DEPRANDUS, may be distinguished from GYMNOTHORAX by the very long jaws and the peculiar dentition. As to its nasal barbels and the insertion of the dorsal fin nothing is known.

I have also another lower jaw of an eel, from Alhambra, about two inches long, with a single row of sharp, close-set teeth, those behind a little shorter, some toward the front somewhat longer, the teeth all sharp and turned forward. This may represent a different species.

## Order SYNENTOGNATHI

### Family VIII. ROGENIIDÆ.

This provisional family, known only from a single fossil genus, may be characterized by the short median dorsal which is opposite the anal and similar to it in size and form. The body is elongate, the mouth large, the snout without beak, the ribs rather strong, the vertebræ about 35 in number.

Of the scales, the pectoral and ventral fins, nothing is known. The genus ROGENIO may belong to the SYNENTOGNATHI, but all the living forms of that order have the dorsal fin placed behind the middle of the body.

#### 22. **Rogenio solitudinis** Jordan.

Plate 17(*b*).

ROGENIO SOLITUDINIS Jordan, *Univ. Cal. Publ.*, Geology, 5, 128, fig. 23, 1907. (Soledad Pass, Moore's Cañon.) Jordan, "Fossil Fishes S. Cal.," p. 6, pl. II, fig. 1, 1919.

This little fish, represented by many specimens, none over 1½ inches long, is characteristic of the rocks which I have provisionally called the Soledad formation, belonging to the lower Miocene or perhaps Oligocene age.

The genus is quite unlike any living form known to me. The dorsal and anal fins are both near the middle of the body, and similarly formed. The mouth seems large, the specimens examined have no pectoral nor ventral fins and no scales. The forked caudal shows no hypural plate. The vertebræ are about 40 in number. On the drawing of this species we have placed no scales. The short dorsal and anal may not be elevated in front.

#### 23. **Rogenio vanclevei** Jordan and Gilbert.

Plate 25(*a*).

ROGENIO VANCLEVEI Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 25, pl. XXXI, fig. 3. (Bairdstown, near Los Angeles; middle Miocene.)

This little fish, the type 1¼ inches long, seems plainly allied to ROGENIO SOLITUDINIS, having the dorsal and anal fins median and opposed, similar to each other. Compared with R. SOLITUDINIS its vertebræ are fewer, about 33; delicate ribs are well preserved, the general appearance of the abdominal region being much as in SCOMBERESOX. No scales are evident and pectorals and ventrals are reduced to doubtful traces. In our

drawing we have ventured to add scales, a lateral line along the belly and falcate fins as developed in SCOMBERESOX. But no certainty is attached to any of these characters, and the artist counts more rays in dorsal and anal rays than I was able to find.

A second specimen (No. 721), also 1½ inches long, has been sent by Mr. E. E. Hadley from Alhambra. It agrees closely with the type, but the fin rays can not be enumerated. I count 31 vertebræ.

## Family IX. **FORFICIDÆ.**

This provisional family is characterized among the SYNENTOGNATHI, by the forward insertion of the dorsal fin, which is relatively long, and by the larger and less numerous vertebræ.

### 24. **Forfex hypuralis** Jordan.

Plate 21(*b*).

FORFEX HYPURALIS Jordan, "Fossil Fishes S. Cal.," p. 36, pl. XIV. fig. 3. (Pine Cañon, Santa Maria oil fields, in soft clay shales of Monterey age.)

This little fish is remarkable for its long and slender beak, and equally so for its many-rayed and rather high dorsal fin, placed in the middle of the back. This character sets off the genus FORFEX from all the other long-beaked fishes which constitute the order SYNENTOGNATHI. In all the living forms, without exception, the dorsal fin is behind the middle of the body, and opposite the anal fin. The hypural plate is especially large in FORFEX. The vertebræ (38) are much fewer than in BELONE, SCOMBERESOX, and related forms. In our drawing the scales are drawn after SCOMBERESOX. The actual length of the long and slender upper jaw and of the anal fin are uncertain elements, as is also the outline of the strong caudal fin. These traits are filled in from related species. Nothing is known of the scales.

### 25. **Zelotes alhambræ** Jordan, new genus and species.

Plates 12(*a*), 26(*a*).

The type of this species (No. 236) was sent from Alhambra, Cal., by Mr. E. E. Hadley. It occurs in the impure diatomaceous shale of the Monterey period, the level which also crops out at El Modena, Bairdstown, and Covina. The locality elsewhere recorded as "Shorb" is the pit excavated for road-mending near the station of Alhambra. At Bairdstown an entire hill is of diatomaceous shale, in which only the surface is yet examined.

This is the posterior part of a fish, the part preserved being 7 inches long, the whole animal in life something over a foot.

It looks remarkably like ZELOSIS HADLEYI. It is, however, a little more slender, the depth at front of dorsal being but half the distance from that point to base of caudal, about 3/7 in ZELOSIS HADLEYI. The vertebræ in ZELOTES ALHAMBRÆ are much longer, with stronger neurals and hæmals; vertebræ under dorsal fin twice as long as deep, much constricted, those of the caudal portion of the vertebral column 16 in number (36 in ZELOSIS HADLEYI), the total number probably not over 35, while in ZELOSIS HADLEYI there must have been upward of 58.

Dorsal fin inserted near middle of body, much farther forward than in ZELOSIS and longer than in the latter genus, its rays about 24; the anterior elevated, a little less than half height of body below. Interneurals slender, about two to each pair of neurals, interhæmals still smaller, very slender and oblique, much shorter than the hæmals. Anal beginning nearly under eighth dorsal ray, its rays about 16, the last very slender. Caudal fin large, deeply forked, the lower lobe one-third longer than the upper, its length 1½ in distance from its base to front of anal (lower lobe in Z. HADLEYI 3¼ times in this distance). Scales numerous on type, but caducous, rather larger than in Z. HADLEYI.

This species cannot be placed in the genus ZELOSIS on account of the longer dorsal and its forward insertion, with much longer and fewer vertebræ and larger caudal fin. The inequality of its lobes makes it certain that its relationships are not far from HEMIRAMPHUS, but the form of the head both in this species and in ZELOSIS HADLEYI is yet to be ascertained. In both, we have drawn the scales and anterior parts from CHIODORUS ATHERINOIDES, a hemiramphine fish, without beak, found in southern Florida.

The genus ZELOTES is characterized especially by the long dorsal fin, inserted much farther forward than in any of the true HEMIRAMPHIDÆ, much as in the extinct genus, FORFEX. Whether its type possessed the long and slender beak of FORFEX I do not know. I have not ventured to insert it on the drawing. In both genera the number of vertebræ is much less than in the HEMIRAMPHIDÆ.

## Family X. **HEMIRAMPHIDÆ.**

### 26. **Rogenites bowersi** (Jordan).

Plate 20(*a*).

ROGENIO BOWERSI Jordan, *Univ. Cal. Publ.*, Geology, **5**, 130, fig. 24, 1907. (Brown's Cañon, Sierra Santa Monica; lower Miocene or Oligocene.)

ROGENITES BOWERSI Jordan, "Fossil Fishes S. Cal.," p. 8, pl. XI, fig. 1, 1919, same plate).

This little fish bears some resemblance to ROGENIO SOLITUDINIS found in the same rocks. It differs markedly, however, in having both

dorsal and anal inserted posteriorly, not far in front of the caudal. The number of vertebræ, about 60, is much greater than in ROGENIO, much as in SCOMBERESSUS. The head seems to be large, with a large mouth, perhaps larger than shown in our drawing. There is no evidence of a beak, but that feature is also wanting in COLOLABIS and GRAMMICONOTUS, living genera of SCOMBERESOCIDÆ. The tail vertebræ are progressively smaller, without hypurals, resembling the SCOMBERESOCIDÆ in this regard, and the genus seems nearer to the short-nosed COLOLABIS of that family than to ROGENIO. In our plate, have omitted scales; the pectorals and ventrals are conventional and the form of the head approximate only.

Mr. Regan is probably right in placing the genus COBITOPSIS Sauvage among the HEMIRAMPHIDÆ.

### 27. **Zelosis hadleyi** (Jordan and Gilbert).

Plate 26(*b*).

CLUPEA HADLEYI Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 29, pl. XIII. (El Modena.)

ZELOSIS HADLEYI Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 24, pl. XXIX (same specimen).

This fine fish, of which the body, skeleton, scales, and bases of the fins are well preserved, was taken by us at first for a herring. The study of the interneurals and interhæmals, however, showed at once a very different relationship. The position of the dorsal and anal, in connection with the posterior insertion of the ventrals, is found in but two groups, and these quite unrelated, ALEPOCEPHALIDÆ and HEMIRAMPHIDÆ. In the latter, the ribs are strong, much as in ZELOSIS, and the general make-up harmonizes with that family. Lacking the head and pectoral fins and uncertain as to the outline of the dorsal and anal, we have ventured to draw these traits from the living genus CHRIODORUS of the Florida coast. The second specimen of ZELOSIS HADLEYI, which I have returned to its discoverer, is simply the counterpart of the type example. I shall await with much interest the discovery of the head, as without it the affinities can not be exactly determined.

In ZELOSIS the vertebræ are small and numerous, about 58 in number, the ventral fins are very small, and the lower lobe of the caudal is scarcely longer than the upper. The dorsal is inserted far behind middle of body, much behind ventrals, and is scarcely longer than the anal, both being rather long. The scales, well preserved, are rather larger than in HEMIRAMPHUS, but we feel little doubt that this genus belongs in or near the HEMIRAMPHIDÆ, an ally of the living CHRIODORUS and of the extinct COBITOPSIS.

## Family XI. SCOMBERESOCIDÆ.

### 28. Scomberessus acutillus (Jordan and Gilbert).

Plate 27(*a*).

SCOMBERESOX ACUTILLUS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 37, pl. XIV, fig. 2; pl. XVII, fig. 1*a*. (El Modena.)

SCOMBERESSUS ACUTILLUS Jordan, "Genera of Fishes," **4**, 571, 1920.

This little fish is known from three examples taken at El Modena, one of them received since the original description. These agree in most regards with the allied living species, SCOMBERESOX SAURUS L. The fossil form is rather more slender, with longer beak, and it possesses one character I have regarded as generic, longer dorsal and anal fins, the former of 12 or 13, the latter of 19 rays.

In SCOMBERESOX there are about 9 dorsal and 12 anal rays. The vertebræ in SCOMBERESSUS number 56.

In our drawing the scales, finlets, and the form of the dorsal and caudal fins are taken from SCOMBERESOX.

### 29. Scomberessus edwardsi (Jordan and Gilbert).

SCOMBERESOX EDWARDSI Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 37, pl. XVIII. (Elysian Hills, Los Angeles, in Miocene sandstone.)

This large Skipper seems to differ from the preceding in the stouter body, shorter snout and larger scales. Only the anterior half of the fish has been found, and it is only by inference that we place it in SCOMBERESSUS.

## Family XII. BELONIDÆ.

### 30. Beltion peronides Jordan.

Plates 3(*a*), 24(*a*).

BELTION PERONIDES Jordan, "Genera of Fishes," **4**, 571, 1920. (Lompoc.)

The genus BELTION is apparently a Needle-fish with excessively long and slender jaws, twice as long as rest of head; the upper slightly turned upward at tip; teeth small, even, not very sharp; opercle strong; scales, if correctly interpreted, comparatively large, larger than in BELONE or TYLOSURUS; ribs weaker than in most related forms. A most interesting genus of fishes, apparently ancestral to the modern Needle-fishes or Silver-gars.

The type of BELTION PERONIDES (No. 52) is the head and half of the body of a large Needle-fish, the part preserved, with jaws, 14 inches long, the whole animal in life about two feet in length.

Head with the jaws equal, very long and slender, each tapering to a long point and somewhat divergent at tip, the lower very slightly the longer; jaws from eye double the length of rest of head; opercle very

large, 4½ times in length of head before it. Jaws armed with bluntish, close-set, even teeth, evident on the base of the jaws, but not preserved on the tip; preopercle triangular, broad below; eye about 6½ in head.

Body elongate, terete, its depth 3½ in length of head; 29 vertebræ preserved, these rather small and quadrate; ribs slender, turned backward; neurals and hæmals subequal, rather short and slender, the longest about 6 in head, dorsal fin, anal and caudal region wanting; pectoral fin short and narrow, about 8 in head; an obscure trace of abdominal ventrals. Some rather large scales present along dorsal region and elsewhere on body, these about one-fourth diameter of orbit. Pectoral normal, 4 in depth, its rays about 17, slender; ventrals with 10 to 12 slender rays.

A portion of the jaw of a second specimen, from Lompoc, has been placed in the museum of the California Academy of Sciences.

From Belone and Tylosurus, the genus Beltion seems to differ in the smaller, more even teeth and the larger scales. I shall await with interest the discovery of the posterior half of the body.

## Order LOPHOBRANCHII

### Family XIII. SYNGNATHIDÆ.

#### 31. **Syngnathus avus** Jordan and Gilbert.

Plate 28(*b*).

SYNGNATHUS AVUS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 34, pl. XXIX, fig. 2. (Bairdstown.)

This little pipe-fish is very close to living California species, especially to S. LEPTORHYNCHUS Girard. It seems rather common in the Miocene shales about Los Angeles. I note no difference which could possibly be regarded as generic. This species, with the existing California forms, approaches the European type of the genus (SYNGNATHUS ACUS L.) in having the dorsal fin inserted on the first ring before the vent. In the species of our Atlantic coast, the dorsal is inserted on the fourth or fifth ring before the vent, a feature worthy of subgeneric recognition.

# Order ANACANTHINI

## Family XIV. GADIDÆ.

### 32. **Eclipes veternus** Jordan and Gilbert.

Plate 31(*b*).

ECLIPES VETERNUS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 47, pl. VIII, fig. 4. (El Modena.)

MERRIAMINA ECTENES Jordan and Gilbert, *l. c.*, p. 56, pl. XXVI, figs. 1–3. (El Modena.)

This species is known to us from a number of young fishes from El Modena. In one of these the tail was so broken that the high lobes of the dorsal and anal seemed to constitute a caudal fin, and the anterior parts of the body seemed distinctly percoid; we therefore placed the species among the APOGONIDÆ under the name of ECLIPES VETERNUS. The other specimens had the head imperfect, but the body and fins were obviously gadoid, and these were described as a new genus, MERRIAMINA. To our regret, the name ECLIPES, based on error, has page priority over the other. This genus was provisionally placed by us among the MERLUCCIIDÆ. But comparison of the skeleton with that of MERLUCCIUS shows that the arrangement can not be justified. MERLUCCIUS is characterized by the presence of very long and strong lateral processes on the abdominal vertebræ; similar but smaller processes occur in most or all of the GADIDÆ. But in ECLIPES these are much reduced.

Still we see no place for the genus other than among the GADIDÆ. The median depression of the dorsal and anal suggests this relationship as also the form of the head.

The three species of ECLIPES of southern California differ considerably in the form of the vertebræ and in the insertion of the caudal fin, which in the one is truncate, in the others lunate. In ECLIPES VETERNUS the vertebræ are relatively short, and the neural spines of the abdominal vertebræ are relatively strong. In ECLIPES MANNI the last vertebræ are shortened, while in ECLIPES EXTENSUS they continue long and slender to the end.

### 33. **Eclipes manni** Jordan, new species.

Plates 12(*b*), 31(*a*).

Type No. 543, a beautifully preserved example, 17½ inches long, from Lompoc. Head 5⅓ in length, depth 7⅔. Body elongate, compressed; head short, with rounded profile; mouth moderate, oblique; jaws

subequal or the lower jaw slightly projecting, the mandible rather more than half head; traces of a few small teeth in lower jaw.

Vertebræ slender, $12 + 28 = 40$, the anterior rather small and crowded, the median ones much longer, strongly constricted, twice as long as deep, the posterior similar but smaller, those at base of caudal little constricted; vertebræ with small transverse processes, the last four at base of caudal as deep as long. Neurals rather strong, the anterior straight, the median ones curved; hæmals much weaker; interneurals and interhæmals all short and slender. Fins in the type all more or less broken, the dorsal rays about 65, the anal about 60; dorsal continuous, of soft rays only, apparently depressed mesially, the posterior rays moderately elevated, falling far short of reaching caudal fin; last rays low, nearly half head, about equal to length of vertebræ, caudal relatively long, lunate, a little more than half head. Pectoral long and slender, 1¼ in head, nearly reaching anal; ventrals obliterated. Scales quite small, preserved in the thoracic region.

No. 53, 8½ inches long, also from Lompoc, seems to be the same species though more distorted, the long vertebræ crowded in front, where the neurals are larger. Ventrals broken, apparently short, jugular, few-rayed; dorsal and anal mesially depressed.

Another example shows the backbone better, each vertebra having a distinct lateral process.

This species apparently belongs to the genus ECLIPES (= MERRIAMINA), but the vertebræ are much longer and more constricted than in ECLIPES VETERNUS, the dorsal and anal lobes are lower, and the tail much exserted beyond them; the caudal fin is larger and lunate. The species is named for Dr. Albert Mann, in recognition of his interest in the Lompoc deposits.

### 34. **Eclipes extensus** Jordan, new species.

Plate 9(*c*).

Type (No. 716, from Alhambra, with counterpart 716A) 3 inches long, being the tail only of a long and slender fish. This has the general form of ECLIPES MANNII, also with some of the last rays of the dorsal elevated twice the height of the body below. But these rays fall short, by more than their own length, of reaching the base of the caudal fin, the 10 vertebræ more or less behind the last high ray bearing short rays gradually shortened backward to the last, which is near base of caudal fin. Caudal fin large, lunate, much longer than in ECLIPES VETERNUS, about equal to length of 8 vertebræ. Vertebræ long and slender, constricted, nearly three times as long as deep. These little fishes have the vertebræ even to the very last one, elongate, twice as long as deep.

Numerous fragments found in the same deposit belong to this species, but none adds much to our knowledge. One of these (No. 717) shows a crushed head, rather long, about 4 in length of body; pectorals narrow and rather long, less than half head, the depth about 1¾ in head, the vertebræ less elongate anteriorly. This specimen permits a total estimate of 45 in all, at any rate from 40 to 50. Another (No. 718) shows the dorsal and anal mesially somewhat lower than posteriorly but continuous. The long tail, with stronger caudal fin and with more elongate vertebræ, distinguishes this species from ECLIPES VETERNUS, the tail being much exserted beyond the elevated rays of dorsal and anal.

### 35. **Arnoldina iniistia** Jordan and Gilbert.

Plate 30(*a*).

ARNOLDINA INIISTIA Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 63, pl. XXVII, fig. 2. (Sunset Bluff, Los Angeles.)

This little fish shows a well-preserved vertebral column with the first dorsal intact of about eight slender rays inserted at the nape. The second dorsal, anal, ventrals, and caudal are obliterated. The head seems rather long and the snout somewhat conical and the mouth rather large. We have assumed the form to be an ally of POLLACHIUS and have framed the lost fins, the scales, jaws, and barbel accordingly. It is possible that the second dorsal and anal were undivided in life, but I see no reason to question its relation to the GADIDÆ, as a young Pollack or Tom Cod.

# Order HETEROSOMATA

## Family XV. PLEURONECTIDÆ.

### 36. Evesthes jordani Gilbert.

Plate 34.

EVESTHES JORDANI J. Z. Gilbert, *Univ. Cal. Publ.*, Geology, 5, 407, with plates, November, 1910. (Lompoc.)

This species I find rather common in the diatom deposits of Lompoc. The genus seems closely related to the living HIPPOGLOSSINA, and in our restoration we have shown the scales and lateral line of that genus. The eyes are probably on the left side, the numbers of fin rays not quite certain. Our restoration differs in no important respect from that made by Mr. Atkinson under direction of Dr. J. Z. Gilbert in 1910. The teeth in the earlier drawing are, however, much stronger than the specimen indicates.

### 37. Evesthes hooveri Jordan.

Plates 11, 35.

EVESTHES HOOVERI Jordan, "Fossil Fishes, Lompoc," p. 38, pl. XXVI. (Lompoc.)

This fine flounder is clearly an EVESTHES, apparently differing from EVESTHES JORDANI of the same deposits by the presence of more dorsal and anal rays, and in the shorter, more oblique mouth. The body seems also rather deeper. The scales, lateral line, and exact form of the dorsal in the plate are drawn from living species of HIPPOGLOSSINA. The eyes and color were probably on the left side in life, and the mouth was possibly larger, as the tip of the snout in the type has been injured. Another specimen (No. 53) is a fine large flounder, 16 inches in length, very well preserved, the front of the head and a few fin rays obliterated.

Head broken anteriorly, the size of the mouth not shown, depth of body 1⅖ in distance from first vertebra to caudal; vertebræ 32 in number as in EVESTHES JORDANI and E. HOOVERI; length of pelvic border, from vertebral column to base of anal, 2⅕ in distance from first vertebra to base of caudal; fins essentially as in EVESTHES HOOVERI, the dorsal with at least 66 rays, the anal nearly or quite 50. Caudal broad, fan-shaped, its length at least half depth of body. Expanded anterior neural spines straight, longer and much more slender than in the original type.

No. 547, 13 inches long, seems to belong to this species, distinguished from EVESTHES JORDANI by the deeper body and shorter, much more oblique mouth.

Head 3 in length, depth 2. Dorsal rays apparently about 70, anal rays 40 or very near that number, vertebræ 32.

Body deep, compressed, head large, the mouth very oblique, the jaws subequal, the mandible about half head; vertebræ 32; hæmals strong, the first one, bounding the belly, rather slender, the rest straight, shortened backward, not longer than the interhæmals, of which there are two to every pair of hæmals; anterior neurals scarcely enlarged or bowed forward, the posterior moderate, straight, much longer than the paired interneurals; hæmals longer than neurals posteriorly, ribs obliterated, hypurals as described in EVESTHES HOOVERI. Pectorals and ventrals obliterated, caudal broken.

Comparing this fish with the type of EVESTHES HOOVERI we see no difference except in the form of the anterior neurals, a matter perhaps of preservation. In EVESTHES HOOVERI the anal rays are 37 in number, not 57 as misprinted in the original account.

### 38. Zororhombus veliger Jordan.

Plate 33.

ZORORHOMBUS VELIGER Jordan, "Fossil Fishes, Lompoc," p. 39, pl. XXVII. (Lompoc.)

The type of this species is very perfect, the only features open to question in the restoration, relating to the bones of the head and the position of the lateral line. As the genus is closely allied to the European Brill (BOTHUS RHOMBUS), we have assumed that the ventrals extend along the ridge of the abdomen and that the eyes and color are on the left side. The genus differs from BOTHUS Rafinesque (RHOMBUS Cuvier) mainly in the very high dorsal and anal fins.

## Order SELENICHTHYES

### Family XVI. LAMPRIDÆ.

#### 39. Diatomœca zatima Jordan and Gilbert.

Plates 4(*b*), 32.

DIATOMŒCA ZATIMA Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 58, pl. XXIV, fig. 3. (Lompoc.) Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 40, pl. XIX. (Lompoc.)

LAMPRIS ZATIMA Jordan, *Scientific Monthly,* 1920, with plates. (Lompoc.)

This species was first made known from the posterior part of the body of a young example. It was there described as an aberrant form of flounder, notwithstanding the peculiar character of its rib structures, not like those of any fish known to us at the time. Later, I found these to agree fairly with those of BRAMA and COLLYBUS in the family of BRAMIDÆ.

Later the posterior half of a much larger fish (No. 57) was received, and still later the whole of a very large example was sent me by Edward J. Porteous, the indefatigable, scientific expert of the Lompoc Celite Company.

This specimen shows that the species belongs to the family of LAMPRIDÆ or Moon-fishes, and that it is a very close ally of LAMPRIS itself, represented among living fishes by a single species. One of the strangest of all fishes that swim the seas is the great Moon-fish or Opah (LAMPRIS REGIUS Bonnaterre), called in California Mariposa or San Pedro fish, and elsewhere Cravo and Jerusalem Haddock. This is a broad, flat fish almost as deep as long, with flattened sides, small, toothless mouth, and short tail with strong muscles at its base. It lives in the open seas, reaching a weight of four hundred pounds, and is likely to appear on any coast, though always very rarely. It has low fins, no scales, and its body colors are a rich brocade of maroon and red with white spots of varying sizes and over all a bright sheen of silver. Its flesh is rich, tender and toothsome, but no person is likely to taste it more than once, as the fish seldom appears twice in the same place. Young specimens I have never seen and I would not know where to look for them, for the fish probably casts its spawn in the open sea.

The one living species of LAMPRIS now recognized is not at all related to any other existing fish and constitutes an order (SELENICHTHYES) by itself. It bears some resemblance to the Pomfret (BRAMA) and to other derivatives of the mackerel tribe, but its likeness is largely superficial and only partially borne out by the skeleton. The two types may, however, have had a common origin, perhaps in Cretaceous times. The bony frame-

work shows many unique features, the most important being the extraordinary development of the shoulder girdle. The clavicle and hypocoracoid are both excessively enlarged and separated by an interspace, the latter flattened and more or less fan-shaped downward, both bones being proportionately many times as large as in any other fish. The hypercoracoid, pierced by a large foramen, is also much enlarged and so placed that the actinosts or "wrist-bones" of the pectoral fin form a horizontal series, and the long oar-like fin can only move up and down. Behind the coracoids, the postclavicle extends as a long spear-shaped separated bone. Besides these features, the Moon-fish has very large and expanded pelvic bones, which support strong ventral fins each with fifteen long rays, a marked contrast to the one spine and five soft rays of most spiny-rayed fishes.

Among the relics of these predatory invaders of the diatom beds is a very complete skeleton of a second species of Moon-fish, three feet long by about two broad. From LAMPRIS REGIUS it differs in the somewhat larger mouth, and especially in having the hypocoracoid broader and subtruncate, much less rapidly rounded off at its bottom.

These specimens are of great interest as showing the antiquity of one of the most peculiar of all living bony fishes, and incidentally with other associated forms, the relative age of the present fish fauna of California.

In No. 600, 33 inches long, the head is $3\frac{3}{5}$ in length to base of caudal; depth $2\frac{1}{8}$; width of hypocoracoid at base $5\frac{2}{3}$ in length of body, $1\frac{1}{10}$ in its own height, height of dorsal lobe 4 in body (this measured on No. 62A, in which the fin is perfect); pectoral $1\frac{2}{5}$ in head, ventral $1\frac{2}{5}$, the dorsal lobe being higher than either. Dorsal rays 54, anal rays 32 or more, ventral rays about 20; maxillary $2\frac{1}{2}$ in head, pelvis a little longer than deep, its length $3\frac{1}{2}$ in head; vertebræ about $16 + 24 = 40$, quadrate, deeper than long, each with 5 to 7 grooves.

Clavicle broad and strong, its outer surface convex, the bone formed as in LAMPRIS, a wide interspace separating it from the still larger hypocoracoid, which is very large, somewhat fan-shaped, subtruncate at base (not rounded off as in LAMPRIS), its breadth at base $1\frac{1}{4}$ in its height, which is about equal to length of head; head deeper than long, the small, toothless mouth larger than in LAMPRIS REGIUS; orbit about 5 in head; anterior ribs short, slender, and straightish, the others strong and curved, the last 6 or 8 closely appressed to the first interhæmals. First four hæmal processes short, progressively lengthened backward (as in the living genus COLLYBUS), this character shown better in the small example, which was the original type of the species. Anterior interhæmals 8 to 10, much bowed forward, their tips again turned backward, their bones growing progressively shorter and straighter backward.

Anterior interneurals straight, long, and slender, longer than neurals, mesially shorter, the last again enlarged, but still not one-fourth the length of the long curved neurals. Post-clavicle well developed as a long and slender rod.

Actinosts placed horizontally as in LAMPRIS, so that the long pectoral can move only up and down.

Dorsal fin very high in front, falcate, its rays curved backward and simple; mesially the fin becomes low, growing again higher and rounded behind. Anal much shorter than dorsal, low in front, rising backward, formed like posterior part of dorsal.

This Miocene fossil is evidently a species distinct from the existing one. The genus DIATOMŒCA can, however, be separated from LAMPRIS, if at all, by two characters only, so far as I can see. These are the much broader, subtruncate, hypocoracoid, and the larger mouth.

Besides the large example (No. 600) described above, we have since received another about 25 inches long (62A, with its counterpart 62B), also in good condition, and entirely similar to No. 600.

Another specimen (No. 57) shows the posterior part of the body, without caudal, of a fish as large as No. 600. It is finely preserved, the length of the fragment 9 inches, the total original length about 15; the breadth, exclusive of fins, about 8 or more than half the length from snout to base of caudal. Dorsal rays as preserved about 25; anal about the same; 21 vertebræ preserved, deeper than long, finely grooved. The caudal portion of the vertebral column with about 25 (estimated total $16 + 25 = 41$) neurals and hæmals, very strong, moderately curved, shortening rapidly backward. Interneurals short and weak, nearly straight, not dilated; one for each neural, with occasional additional ones between; the longest interneurals one-third the length of the longest neurals; interhæmals much longer and stronger, the posterior nearly straight, the anterior much curved, at first forward, then backward; mostly one interhæmal for each hæmal, but a few intercalated, the longest (anterior) interhæmals half as long as the longest hæmals; a widened hæmal behind abdominal cavity, bearing three strong, much arched interneurals; the neurals before it dilated and much curved forward.

This specimen is evidently identical with the original type, but much larger. The part preserved does not extend quite so far forward and does not show the peculiar adjustment of the ribs to the anterior hæmals characteristic of the BRAMIDÆ.

# Order ACANTHOPTERI

## Suborder PERCESOCES

### Family XVII. ATHERINIDÆ.

#### 40. Zanteclites hubbsi Jordan and Gilbert.

Plate 29.

ZANTECLITES HUBBSI Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 39, pl. XV, fig. 3; pl. XVI. (Bairdstown, Shorb.) Jordan and Hubbs, "Monogr. Rev. Atherinidæ," 1920.

This genus plainly belongs to the ATHERINIDÆ, being distinguished from all the living American species by the much greater development of the first dorsal, which has 12 or 13 spines, the longest of them more or less flexible at tip. The soft dorsal rays cannot be exactly counted, and may have been fewer than our plate shows. In other details our drawing must be fairly correct. The number of dorsal spines is greater than indicated in our original description, as in this we failed to count the interneural bones to which spines now obliterated had been attached. The dorsal spines are 12 in number, the anal rays I, 12, the vertebræ about 38. Two additional specimens of this species have been sent from Alhambra by Mr. Hadley.

The dorsal fins in ZANTECLITES are nearer together than in any living American genus, none of them being closely allied to it. It bears some resemblance to primitive forms still extant in Australia, but this likeness may be deceptive. All these individuals are small, from 3 to 4 inches long.

## Suborder PERCOMORPHI

### Family XVIII. SCOMBRIDÆ.

#### 41. Auxides sanctæ-monicæ Jordan.

AUXIDES SANCTÆ-MONICÆ Jordan, "Fossil Fishes S. Cal.," p. 70, pl. V, fig. 2. (Soledad formation; lower Miocene or Oligocene.)

This species, represented by several much abraded specimens, is a fish closely allied to SCOMBER, apparently with a short first dorsal and the body evenly covered with small, smooth scales. Compared with the living genus SCOMBER, AUXIDES has larger scales, stronger dorsal spines, more oblique mouth, and in the type of the genus the same number of vertebræ 30 or 31.

The number of vertebræ in the original type of this species I now think could not be less than 30, the number recorded in AUXIDES PROPTERYGIUS (Agassiz), the European type of the genus. AUXIDES must be nearer SCOMBER than AUXIS, as the latter has part of its vertebræ peculiarly modified.

### 41a. Auxides dasson Jordan, new species.

Plates 3(*b*), 36(*a*).

The type of another species, allied to XESTIAS and AUXIDES is represented by two good specimens, evidently identical, from the diatomaceous shales of El Modena.

To this species I refer two good specimens of the same fish, from the diatomaceous shales of El Modena, presented by Mr. Delbert Brunton. The one (No. 66), $7\frac{1}{2}$ inches long, is the posterior half of the body. The other (No. 67), 6 inches long, is the head and anterior part of another example of the same species. The two could not have been parts of the same individual, as the front of the spinous dorsal fin is present on both examples.

Body rather slender, compressed, the head about 3 in length, the depth 6, the posterior part tapering to a slender tail, the last vertebra of which lacks neurals and hæmals. Vertebræ in all about 35, including those of nuchal region, rather longer than deep, especially posteriorly, their surface finely grooved. Neurals moderate, shortened behind, interneurals very small, barely a fourth length of neurals; hæmals posteriorly similar to neurals, those anteriorly giving place to long, curved ribs, $3\frac{1}{2}$ in depth of body; the ribs are unusually strong, but much weaker than in our No. 70. Spinous dorsal rather high, of 8 or 9 slender species rapidly shortened backward. Behind these the presence of about a dozen very small interneurals indicates as many very short spines, all lost in this example. Space between last visible spine and front of second dorsal equal to length of nine vertebræ, $1\frac{1}{6}$ in depth of body at front of anal, much less than length of a rib. Other fins all broken, the caudal, ventrals, and pectorals showing nothing distinctive. Eye preserved, about $\frac{2}{3}$ length of snout, lower jaw projecting.

Scales large for a mackerel, much as in TUNITA and AUXIDES.

These specimens may possibly belong to AUXIDES SANTÆ-MONICÆ of the Soledad formation, but the condition of the type specimens of the latter is such that no satisfactory comparison is possible.

### 42. **Auxides bruntoni** Jordan, new species.

Plate 9(*a*).

A part of another mackerel (No. 70), with broken head and no fins, is sent from El Modena by Mr. Brunton. This has 16 stout vertebræ, each longer than deep, before front of anal. The neurals are strong, and the four or five anterior interneurals preserved are especially so, the foremost or longest interneural reaching nearly to base of neurals; hæmals before anal strongly bent backward. First two or three hæmals apparently short and broad; ribs very long, strong, flattened considerably and curved backward, each as long as 6 or 7 vertebræ. No scales are preserved. This example seems closely related to XESTIAS IRATUS, as the strong, smooth bones indicate. It is named for Delbert Brunton, a former student, now of Fresno, but formerly teacher in the high school at Orange.

It is a great pity that the grading of "Hews Park" at El Modena has filled up and obliterated the fine deposit of fossils.

### 43. **Xestias iratus** Jordan, new genus and species.

Plate 4(*a*).

No. 222, 7 inches long, the whole fish in life about 18, with a separated fragment containing 9 vertebræ and part of the dorsal and anal fins.

Head exceptionally well preserved, its length a little more than greatest depth of the fish, its bones enameled and shining black; jaws long, subequal; maxillary about 2¼ in head; premaxillary long and slender, with a marginal line of sharp, wide-set, slender, unequal teeth, probably about 32 in all, maxillary narrow and curved, parallel with it; lower jaw with a row of similar teeth. Eye about 5 in head, the eyeball well preserved; preopercle set obliquely; bones of head entire.

Vertebræ hourglass shaped, a little longer than deep, the number probably about 35 to 40. Nine spines preserved in the dorsal fin, the number doubtless much larger, the highest 2⅖ in head; interneurals short and strong, shorter than the neurals, but stouter; pectorals obliterated; ventrals thoracic, badly broken; branchiostegals 9 or 10; ribs very strong, broad and flat. Interneurals of second dorsal slender, close-set, much shorter than neurals; only a few hæmals preserved, these short and weak, the fin opposite the soft dorsal.

This is evidently a scombroid fish, but distinct from any thus far described. It cannot be an AUXIDES, as the dentition seems quite different. The specific name IRATUS alludes to the snarling expression on the face of the type-specimen. XESTIAS seems related to TUNITA and TURIO, differing in dentition and in the greater strength of the ribs. The bones are notably smooth and polished (ξεστός).

### 44. **Tunita octavia** Jordan and Gilbert.

Plate 39.

TUNITA OCTAVIA Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 42, pl. XII, fig. 2. (El Modena.)

This well-marked form is related to the living genus SCOMBER, from which it differs in the closer approximation of the dorsal fins, in the larger scales and the more ovate form of the body. In our drawing, the scales are a little too large, not sufficient allowance being made for their imbrication, and the dorsal spines a shade too robust. The mouth may have been larger and the finlets and tail are drawn after other mackerels. No. VIII, from Lompoc, referred by us at first to this species, probably belongs to TURIO WILBURI. The vertebræ number about $12 + 16 = 28$, as in TURIO.

The number of dorsal spines as shown in our drawing is approximately correct, as there are traces of interspinal bones not counted in the original description.

### 45. **Tunita** (species undescribed).

Still another mackerel is represented by 68A and 68B, counterparts, 4 inches long, in impure diatom shales, supposed to be of Miocene age, sent from Covina by Mr. Willard Mallory.

In the specimen, the front of the torso from the spinous dorsal downward appears, head and tail being wanting. About 12 vertebræ are present, quite slender and hourglass-shaped. Body comparatively deep; ribs rather few, very strong and curved backward. The neurals and interneurals shown are moderate, the latter longest; dorsal spines not to be counted; anterior hæmals unusually long and straight, reaching nearly to the anal fin and longer than the interhæmals. Scattered scales, relatively large, much as in TUNITA, or even rather larger, are shown in the specimen.

This fish seems shorter and deeper than any other of the Mackerel family from the Miocene. The vertebræ are much as in TUNITA, but the ribs are longer and stronger than in TUNITA OCTAVIA, the vertebræ much weaker than in XESTIAS.

### 46. **Zaphleges longurio** Jordan.

Plate 38(*a*).

ZAPHLEGES LONGURIO Jordan, "Fossil Fishes, Lompoc," p. 23, pl. XIII. (Lompoc.)

This fine large fish is no doubt a mackerel, distinguishable from the others by many (54) vertebræ, moderate-sized scales, broad, fulcrate caudal and large mouth, with slender, conical teeth.

The posterior interneurals are strong, the anterior obliterated, as are also all the interhæmals in the type, but a second example, apparently of the same species (No. 55), has the interhæmals extremely small. The caudal fin is broader and its peduncle more robust than in the other mackerels.

In the accompanying plate the form of the head is uncertain, and we are not sure of the number of dorsal spines, the posterior ones being short and weak. The scales are probably drawn too large for a reason already indicated in other species, and the position of the lateral line is a matter of speculation, as is also the height and form of the fins, the very large caudal excepted.

The genus is probably intermediate between SCOMBER and SCOMBEROMORUS, the two most primitive types of SCOMBRIDÆ.

A second specimen (No. 55) about 22½ inches long, with the head crushed and tail broken, I refer also to the ZAPHLEGES LONGURIO.

Body elongate, the depth 7⅔ to base of caudal; vertebræ 54, rather short, and constricted mesially. Head wholly destroyed; neurals strong, anteriorly straight; hæmals anteriorly curved; ribs rather long. Spinous dorsal obliterated, the very short and slender interneurals very obscurely shown, but indicating a low fin, of slender spines, 15 to 20 in number.

Soft dorsal high, with long interneurals which reach more than half way to the backbone; posterior neurals little shortened, the caudal peduncle, therefore, not very slender, its least width half greatest depth of body; soft dorsal rays at least 16 in number, the highest about two-thirds in depth of body. Caudal broken; anal and its structures mostly obliterated; pectoral and ventral detached and broken. The stomach contains two backbones of XYNE GREX, showing the predatory nature of the fish.

No trace of scales. No character shown by this specimen can distinguish it from the genus ZAPHLEGES.

It is possible that No. 127, referred to THYRSION VELOX, in our "Fossil Fishes of Diatom Beds of Lompoc," belongs also to ZAPHLEGES. It is not unlikely that the number of vertebræ in this example were once 50 or more, instead of 40, as originally counted, several of them being crushed with the head.

To ZAPHLEGES LONGURIO I also refer a large fish from Lompoc (No. 298), 25½ inches long. This shows a complete vertebral column with crushed head; all the fins except the caudal wanting, interspinal bones mostly obliterated.

Head about 4⅗ in length; jaws long, at least half as long as head, teeth numerous, even, conical, rather close-set, at least 50 on each side in each jaw.

No trace of scales; caudal peduncle not very slender, each of its vertebræ with spinal bones; caudal fin large.

I do not see any characters which may separate this individual from ZAPHLEGES LONGURIO.

### 47. **Turio wilburi** Jordan and Gilbert.

Plate 37.

TURIO WILBURI Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 15, pls. VI, VII. (Lompoc.)

This small mackerel is rather abundant in the diatom beds of Lompoc. The genus is well distinguished from THYRSOCLES and related genera by the small number of vertebræ, about 28, the segments themselves being more slender and elongate than in THYRSOCLES. The interneurals and interhæmals are very slender, almost hair-like, and the postorbital part of the head is proportionately much longer than in THYRSOCLES, much as in EUTHYNNUS, which genus has, however, a trellised backbone, while that of TURIO, as in all other fossil genera known, is simple. The genus probably finds its nearest living ally in SCOMBEREMORUS.

In our drawing, the form of the head is a little uncertain, the part behind the eye was probably rather longer than the drawing shows, and the details of the mouth can not be verified. The high first dorsal is diagnostic. The lateral line and finlets are shown as probabilities, and the scales, doubtless minute, are omitted.

### 48. **Ocystias sagitta** Jordan.

Plate 38(*b*).

OCYSTIAS SAGITTA Jordan, "Fossil Fishes, Lompoc," p. 38, pl. X. (Lompoc.)

The splendid specimen which is the type of this genus differs from all the other fossil mackerels in its very slender, arrow-shaped body. It is plainly a relative of the living genus, SCOMBEROMORUS, differing in the slender body and short, weak interneurals and interhæmals. The vertebræ number 42.

In our drawing, the details of the head are wholly uncertain, except that the postorbital part is much shorter than in TURIO. The large caudal fin with slender peduncle is drawn from life, but the other fins, with the apparently naked body and the direction of the lateral line, are patterned after SCOMBEROMORUS. The dorsal spines should be somewhat more slender than the figure shows.

### 49. **Thyrsocles kriegeri** (Jordan and Gilbert).

Plate 36(*a*).

THYRSITES KRIEGERI Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 41, pl. XVII, fig. 2, 1919. (Lompoc.)

THYRSOCLES KRIEGERI Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 19, pls. XI, XII, 1920. (Lompoc.)

This species is the most abundant of the mackerels found in the Lompoc deposits, and many specimens in addition to those named in our original paper on the Lompoc fauna have since come to hand. The most important discovery is that indicated on page 45 of our Lompoc paper. The large head, long jaws, and conical teeth supposed to characterize the genus THYRSION are found in THYRSOCLES also, the type of THYRSION VELOX being undoubtedly identical with THYRSOCLES ESCHARION.

The genus THYRSOCLES is a close ally of SCOMBEROMORUS, with which it agrees in general form, and especially in the long, parallel, grate-like interhæmals, differing in the long jaws and close-set conical teeth, in which, and in other traits, it closely approaches the living genus CHRIOMITRA Lockington.

Our drawing must be substantially correct in its details. The mouth is very large, the mandible probably, as in THYRSOCLES VELOX, being about half longer than the rest of the head. The species is best distinguished by the very strong, long and parallel interhæmals. These structures with the strong interneurals neglected by systematists are very helpful in the distinction of the allies of the Spanish Mackerel.

In this, as in most other allies of SCOMBEROMORUS, no trace of scales appears in the fossil. The finlets are drawn from living species as also the general form of the dorsal fin. The two supposed genera THYRSOCLES and THYRSION agreeing in all tangible respects, must be regarded as identical. THYRSOCLES VELOX (ESCHARION) differs specifically mainly in the shorter interhæmal bones, rapidly shortened from the first. The mouth is very large, the maxillary more than half head, and the sharp, conical teeth 50 to 60 in number on each side. The vertebræ are about 50 in number. In T. KRIEGERI we count 48.

The generic name, THYRSOCLES, has page priority over THYRSION as being first printed in connection with a known species.

### 50. Thyrsocles velox Jordan.

Plate 6(*a*).

THYRSION VELOX Jordan, "Fossil Fishes, Lompoc," p. 17, pls. VIII, IX. (Lompoc.)
THYRSOCLES ESCHARION Jordan, "Fossil Fishes, Lompoc," p. 21. (Lompoc.)

A fine and very perfect example of this species, obtained through the interest of Mr. Edward J. Porteous, shows that the head (No. 153), taken as the type of THYRSION VELOX belongs to the same species as the body of a large fish to which I gave the name of THYRSOCLES ESCHARION.

No. 245 is a fairly preserved head and torso; teeth slender, conical, about 50 on the edge of the upper jaw, which is 1⅘ in head; interhæmals long, parallel as usual in THYRSOCLES. It may be that this species is merely an extreme form of T. KRIEGERI.

### 51. Ozymandias gilberti Jordan.

Plate 13.

LUVARUS species, Jordan, "Fossil Fishes of California," *Univ. Cal. Publ.*, Geology, **5**, 134, 1907, with plate. (San Pedro.)

OZYMANDIAS GILBERTI Jordan, "Fossil Fishes S. Cal.," p. 43, pl. XXII. (Miocene rocks at Point Firmin, San Pedro.) (Not OZYMANDIAS GILBERTI Jordan, "Fossil Fishes, Lompoc," p. 36, pl. XXIV, from Lompoc.)

The large specimen which is the type of this species is represented by a vertebral column of a fish which must have been nearly six feet long in life. It is contained in hard, volcanic material. Thus far we have failed to find anything like it, although I suppose it to be the backbone of a Tunny or some similar huge fish of the mackerel family.

The torso of a large fish from Lompoc (No. 332), identified by us with OZYMANDIAS in our paper on the "Fossil Fishes of Lompoc," is certainly different from the type, and it probably belongs to the living genus OPHIODON, abounding in California waters.

In the collection from Lompoc is the head (No. 549) with six vertebræ of a very large fish, apparently a tunny, the head itself being 11 inches long. This, I venture with some doubt, to identify with OZYMANDIAS.

Mouth very large, terminal oblique, the gape nearly straight, the lower jaw with scattered irregular, stout, thick, bluntish teeth, those behind rather smaller; no canines preserved, the interspaces usually greater than the length of a tooth. Fragments of the upper jaw show similar teeth. Maxillary 1⅘ in head, its end just below eye, its tip rather broad; eye obscurely shown; snout pointed, subconical; bones of head finely striated. Branchiostegals long and strong, about 8 preserved; pectorals injured, placed rather low, rather broad; anterior neurals and hæmals strong.

More material is necessary before the relations of this fish can be positively determined, but it will probably prove to be one of the great mackerels or tunnies, differing from THYRSOCLES in the larger, wide-set teeth. A head still larger (No. 310), very poorly preserved, belongs to some very large mackerel, but no useful details can be made out.

## Family XIX. CARANGIDÆ.

### 52. Seriola sanctæ-barbaræ Jordan, new species.

Plates 7, 40.

Type No. 62, from the diatom beds at Lompoc, 27½ inches long, with caudal, is a finely preserved example, except for the disintegration of the bones of the head.

Head 3⅕ in length to base of caudal; depth, at ventrals, 3; front of anal 3⅔. Dorsal rays about VIII-I 33. Anal II, 19 (14 preserved). Ventrals I, 5. Pectorals 10 or 11. Vertebræ 10 + 14 = 24.

Body deep for a SERIOLA, much as in S. ZONATA, ovate, tapering rapidly backward from the front of soft dorsal. Head of type badly crushed, showing nothing distinctive. First dorsal low, of 8 or 9 rather slender spines. Second dorsal inserted close behind it, its first rays slightly elevated, the longest about 2⅔ in head; anal fin similar in form, its anterior rays little elevated, about 3½ in head; base of anal much shorter than that of soft dorsal, much shorter than abdomen; ventrals inserted just behind pectorals, short, about 3 in head; pectorals short, about 3 in head. Caudal strong, well forked, the lobes about 1⅔ in head.

Vertebræ (10 + 14 = 24) large, longer than deep, especially posteriorly, each with four or five grooves. Neurals and hæmals similar, rather strong, well spaced posteriorly; tail slender; vertebræ with short neurals and hæmals; interneurals long and strong, as long as the neurals, two for each pair of neurals anteriorly, three posteriorly. Interhæmals similar to interneurals, the first three, however, much longer than the rest, which are progressively shortened; ribs rather strong, the anterior largest and longest. Sides of back with traces of small scales.

This species seems to be a genuine SERIOLA, differing from the living species (SERIOLA DORSALIS), the "Yellow Tail" of the California coast, mainly in the deeper body, and probably fewer dorsal rays. It is evidently very near to SERIOLA PRISCA (Agassiz) from the upper Eocene at Monte Bolca, Verona.

### 53. Lompochites hopkinsi.

Plate 41(*b*).

LOMPOCHITES HOPKINSI Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 30, pl. XX. (Lompoc.)

No second specimen of this puzzling fish has been received. The strong vertebræ and slender tail indicate affinity with the CARANGIDÆ. The long pelvic bone and consequent backward insertion of the ventrals suggests LOMPOQUIA. But the vertebræ are quite different, and only ten precede the many-rayed anal. The dorsal and anal fins seem to be quite low, the latter, however, nearly as long as the soft dorsal, as in the CARANGINÆ, not short as in SERIOLA. The pectoral is obliterated, probably short in life.

On the whole, we find nothing nearer to LOMPOCHITES than ELAGATIS, which is an elongate SERIOLA, with a better developed or more rayed anal, the anal opposite the dorsal. The head and fins in our drawing are drawn on this supposition, and it is likely that the artist has inserted too many rays in each. ELAGATIS has the dorsal VI-1, 27, besides two finlets, the anal rays II, 17-2. The two small free anal spines, lost with age in ELAGATIS, are not shown in our specimen. The scales were very likely smaller than we have shown, and there were probably none on the opercles.

The characters by which LOMPOCHITES is separable from ELAGATIS are yet to be determined.

## Family XX. POMOTOMIDÆ.

### 54. Lophar miocænus Jordan and Gilbert.

LOPHAR MIOCÆNUS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 44, pl. III, fig. 2; pls. XIX, XX. (Chavez Ravine, Los Angeles.)

This fine species is represented by a very perfect example, found in the clay of a brickyard in Los Angeles, supposed to be of Monterey (Miocene) age.

The genus LOPHAR seems almost identical with POMATOMUS, the Blue-fish of the Atlantic, East Mediterranean, and Australian regions. I note but one difference. The jaws in LOPHAR are provided with thick conical, subequal teeth, instead of sharp slender teeth interspersed with equally sharp canines, as in POMATOMUS. In the drawing, features not shown in the fossil are indicated by dotted lines.

## Family XXI. APOGONIDÆ.

### 55. Eritima evides Jordan and Gilbert.

Plate 42.

ERITIMA EVIDES Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 40, pl. XXIII, fig. 1. Sunset Bluff, Los Angeles.)

The little fish, type of this species, belongs without much doubt to the family of APOGONIDÆ. In the original description we were misled by the number of ventral rays, the ventrals of the two sides being blended together in the fossil.

In the type, the first dorsal is entirely lost. In Mr. Atkinson's drawing we have replaced this fin from other species. The number of dorsal and anal rays is lower than in our original estimate, and probably our plate is not far out of the way. The scales as shown are those of APOGON as none are preserved in the type of ERITIMA. With our present material, we cannot define ERITIMA, as a genus distinct from APOGON or CHEILODIPTERUS. The genera related to APOGON differ mainly in dentition.

## Family XXII. SERRANIDÆ.

### 56. Emmachære rhachites Jordan and Gilbert.

EMMACHÆRE RHACHITES Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 59, pl. XXVIII, fig. 2. (Lompoc.) Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 26, pl. XV, in part. (Lompoc.)

The discovery of a complete skeleton of a second species of EMMACHÆRE shows that the relations of this genus, at first misunderstood, are with the Giant Bass, or Jew-fish (STEREOLEPIS) of the California Coast.

The present species is known from an incomplete torso. The generic details are drawn from the fine large example (No. 220) which I now regard as the type of a distinct species, EMMACHÆRE RHOMALEA.

Compared with STEREOLEPIS, the spines of EMMACHÆRE are stronger, the anal fin has more rays and the ventrals are farther forward.

### 57. **Emmachære rhomalea** Jordan, new species.

Plate 43.

EMMACHÆRE RHACHITES Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 26 (in part, No. 220), pl. XVI. (Lompoc.) (Not of "Fossil Fishes S. Cal.," pl. XXVIII.)

The type of this species (No. 220) is 19½ inches long, figured in Plate XVI of our "Fossil Fishes of Lompoc," and described by us in page 26 as our "best example" of EMMACHÆRE RHACHITES.

Renewed comparison of this specimen with the type of EMMACHÆRE RHACHITES induces us to believe that this specimen, with No. 311, represents a species distinct from the latter. The generic characters seem to be the same, but the new species, E. RHOMALEA, has much slenderer and shorter interneurals, much less dilated at base than in E. RHACHITES. The anal rays seem fewer, III, 8 or 10 at the most, while in E. RHACHITES there are apparently III, 12. The second anal spine is shorter in E. RHOMALEA than in E. RHACHITES. A very tangible difference is found in the insertion of the long interhæmal of the second anal spine. In E. RHACHITES this bone is larger than in E. RHOMALEA, and three hæmal spines are cut short by its extension, these appendages not reaching their full length short of the fourth. In E. RHOMALEA but one or possibly two are cut short, the third being of full length.

Another very young example, less than two inches long, was obtained from the diatom mass at Lompoc, the only very young fish yet obtained from those deposits.

In restoring the species, we have given a conventional EPINEPHELUS head and scales. Whether the caudal fin was rounded or truncate is uncertain.

## Family XXIII. **LUTIANIDÆ.**

### 58. **Neomænis hagari** (Jordan and Gilbert).

Plate 46.

LUTIANUS HAGARI Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 48, pl. XIV, figs. 1, 4. (El Modena.)

Two little fishes, evidently immature, are the young of some snapper-like fish. The actual relationships cannot be definitely made out, as we have no clue as to the dentition. Meanwhile, we place the species provisionally among the LUTIANIDÆ. We have referred it to the genus or subgenus NEOMÆNIS, as no true LUTIANUS occurs on the eastern Pacific. In our drawing, the form of the head and numbers of fin rays are taken from Mexican species. The dorsal and anal spines in the plate are stronger than they should be, for they seem to be very slender in the type specimen. The outline of the back seems too much curved, as in the type the line goes back nearly straight from front of dorsal. It is possible that this fish belongs to the HÆMULIDÆ, as an ally of HÆMULON or POMADASIS. In both these genera the dorsal spines are stronger than in our type.

## Family XXIV. SPARIDÆ.

### 59. Rhythmias starrii Jordan and Gilbert.

Plate 44.

RHYTHMIAS STARRII Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 28, pl. XVII. (Lompoc.)

This fish is plainly one of the SPARIDÆ, allied to LAGODON, SALEMA, and ARCHOSARGUS. In all these genera, however, there is a procumbent spine at the front of the spinous dorsal, but this, if existing, is obliterated in all of our specimens. In these the general features are evident, but the soft dorsal, soft anal, and general features of the head are obliterated, and have been restored to accord with the genus SALEMA, of which one species, SALEMA POURTALESI (Steindachner), is found about the Galapagos Islands. From SALEMA the genus differs mainly in the very strong caudal fin.

In our examples of RHYTHMIAS, the dorsal spines are depressed to the back. In all those which we refer to PLECTRITES the spines stand erect.

Another specimen of RHYTHMIAS STARRII (No. 512), since received from Mr. Porteous and Mr. Starr, is well preserved, 9 inches long, lacking most of the caudal fin, head $3\frac{1}{10}$ in length, depth $2\frac{3}{4}$. General form of LAGODON, the outlines symmetrical; eye as long as snout, $3\frac{1}{2}$ in head; dorsal with 15 soft rays, the first spines obliterated, the antrorse spine, if once present, now lost; second and third anal spines about equal, the rays about III, 15; vertebræ $10 + 14 = 24$. Anterior interneurals touching tips of neurals squarely, posterior interneurals and interhæmals, two for each pair of neurals.

A specimen (No. 547) is 9 inches long, $10\frac{1}{2}$ as a whole. Head 3 in length, depth $2\frac{1}{3}$; dorsal rays about XII, 12, anal certainly III, 8 or 9; vertebræ $10 + 15 = 25$. Body robust, deep, the back arched; eye large, $3\frac{1}{4}$ in head; mouth broken; within it appears a band of molar teeth, 12 in

number, moderate in size and not close-set, in about three irregular series, probably coming from posterior part of lower jaw.

Vertebræ slender, nearly half longer than deep, slightly constricted and strongly grooved; ribs strong, curved; hæmals and neurals long, straight, anterior 2 or 3 interneurals dagger-shaped, winged at base, others very slender, and all but the anterior short, forked at tip; hæmals short and slender, the second long and curved, 1¾ in depth, its spine, however, short, little stouter than the third and no longer; dorsal spines low, appressed to the back as usual in this species; no evidence of procumbent spine. Soft dorsal and caudal largely obliterated, as are also the pectorals and ventrals.

Another example (No. 546), 6½ inches long, with broken fins, belongs also to RHYTHMIAS STARRII. Its depth is almost half its length, mouth small, maxillary nearly 4 in head, jaws equal, a trace of narrow incisors. Anal rays almost certainly III, 11. Vertebræ 10 + 14, slender, two-grooved, mostly deeper than long.

Another (No. 219) is in fair condition, 9 inches long, head 3½ in length, depth 2½, eye shorter than snout, 3⅔ in head. Dorsal rays XI, 12; anal about III, 10, part of the interhæmals and all the rays obliterated.

Still another example (No. 189) is well preserved, but in very friable rock. Head 3 in length, depth 2½, the body deeper and more compressed than in No. 512, the belly more prominent, dorsal rays about XII, 12; anal about III, 12, the counts not certain; vertebræ 24.

### 60. Plectrites classeni Jordan.

Plate 45.

PLECTRITES CLASSENI Jordan, "Fossil Fishes, Lompoc," p. 29, pl. XVIII. (Lompoc.)

This genus is closely related to RHYTHMIAS, differing mainly in the presence in the type of the antrorse spine before the dorsal, a feature which may have occurred in RHYTHMIAS STARRII also. The body in PLECTRITES is a little more elongate and the caudal fin somewhat narrower. The type of PLECTRITES CLASSENI, from which our restoration is made, lacks the lower part of head and thoracic region as well as the caudal fin, but examples later received show these features and indicate that the restoration is substantially correct, although the slenderness of form is less marked than in the original type.

In the fossils, one striking difference, as already indicated, seems to separate PLECTRITES from RHYTHMIAS. In all the specimens of RHYTHMIAS the dorsal spines lie down, being closely appressed to the back. In PLECTRITES all these are maintained erect. The scales are alike in the two genera. PLECTRITES probably finds its nearest living ally in LAGODON, the Sailor's Choice of the Atlantic. This matter can not be definitely settled until we find specimens with the teeth preserved.

One example of PLECTRITES CLASSENI (No. 514), 9⅔ inches long, lacks the posterior part of the back. It agrees closely with the type; ventrals inserted somewhat behind pectorals; mouth small; anal rays III, 13 to 15, the count not quite sure; no trace of the antrorse dorsal spine preserved.

Still another example (No. 470) is 6½ inches long, lacking anterior third of body. Caudal long and strong, ribs strong, as in RHYTHMIAS; anal rays apparently III, 12. The only specimen of RHYTHMIAS or PLECTRITES which shows the antrorse spine characteristic of the living genera, LAGODON, SALEMA and ARCHOSARGUS, is the type of PLECTRITES CLASSENI.

### 61. **Atkinsonella strigilis** Jordan.

Plates 5(*b*), 41(*a*).

ATKINSONELLA STRIGILIS Jordan, "Fossil Fishes, Lompoc," p. 41. (Lompoc.)

This peculiar species, sharply distinguished by its deeply furrowed scales, belongs probably to the SPARIDÆ and may be an ally of the Mediterranean genus BOOPS Cuvier (later called BOX by the same author).

In the original type, which, after our drawing was made, was unfortunately lost or mislaid, the head was crushed, and the anal and caudal fins were destroyed. From another specimen (on the block with which is the dorsal ridge of a third) our photograph has been taken. This specimen shows a very long, soft dorsal fin of about 22 rays, though shorter than indicated in our plate, on which 26 may be counted.

The pectorals and ventrals are, no doubt, correctly interpreted in our drawing. The ventrals are certainly behind the pectorals. The caudal as shown in the second specimen was probably more deeply forked. The details of the head are assumed to concur with the general form of the body. The interneurals in this species are slender and subequal, shorter than the rather strong, straight neurals.

## Family XXV. **OTOLITHIDÆ.**

### 62. **Lompoquia retropes** Jordan and Gilbert.

Plate 47.

LOMPOQUIA RETROPES Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 49, pl. XXIV, fig. 1. (Lompoc.)

Only the type of this species is known, the head damaged, and the posterior parts, behind middle of soft dorsal and anal, lost. It is clearly an ally of CYNOSCION and OTOLITHUS, but its exact place cannot be ascertained without more complete material, especially showing the mouth and teeth. The missing parts have been restored on the supposition that the species resembles ATRACTOSCION NOBILIS (Ayres), its nearest living rela-

tive in California. The size of the mouth and the count of fin rays are not shown in the type. Small scales appear in rows on the side of the abdomen, besides those shown on the head in the type specimen.

As far as I can now see, LOMPOQUIA is separable from CYNOSCION only by the longer pelvic bone and the resultant posterior insertion of the ventrals—opposite middle of the pectoral instead of under the lower axil.

These long-bodied, long-jawed Sciænoid fishes have the vertebræ 14 + 10, instead of 10 + 14 as in SCIÆNA, CORVINA, and the typical genera of the group. The former series may well constitute a separate family, OTOLITHIDÆ. These are more primitive than the typical SCIÆNIDÆ, having the peculiar traits of the group; cavernous skull, blunt nose, and occasional barbels less developed.

### 63. Aristoscion eprepes Jordan.

Plates 6(*b*), 48.

ARISTOSCION EPREPES Jordan, "Genera of Fishes," **4**, 571, 1920. (Lompoc.)

The genus ARISTOSCION is allied to ARCHOSCION Gill and ISOPHISTHUS Gill. It has the form of CYNOSCION, the vertebræ 14 + 10, the anal fin long, its base a little more than half that of the soft dorsal, its rays about I, 15. Dorsal fin low, continuous, but mesially depressed, its rays about XII-I, 19. Caudal fin very large, lunate, the median rays shortest. Head and scales unknown, probably much as in CYNOSCION, from which ARISTOSCION differs, so far as known, only in the long anal fin and in the very large caudal.

The type of ARISTOSCION EPREPES (No. 522) is the well-preserved body of a large fish without the head, having the general form of species of OTOLITHUS and CYNOSCION. Vertebræ 14 (11 preserved) + 10, large, strongly ridged; each vertebra is about one-fourth longer than deep. Head presumably about 4 in length; depth about 5¼ (4½ in distance from gill opening to base of caudal). Pectorals and ventrals detached, rather small, the pectorals showing 8 or 9 rays, the upper longest, the ventrals, I, 5. Dorsal fin low, continuous, apparently mesially depressed, the anterior spines lost, the apparent number of rays indicated by the interspinals, XI–I, 20; soft rays all broken at tip. Anal inserted below front of soft dorsal, its rays apparently I, 15, the spine slender, attached to a long and slender interhæmal; highest anal rays about 2½ in depth. Hæmals and neurals strong, directed well backward, the anterior straight, the posterior curved. Ribs large, directed largely backward. Interhæmals rather short, straight, mostly two for each pair of neurals; interhæmals also small, slender, progressively shorter from the long first interhæmal. Hypural fan-shaped, with about ten radial ridges. Caudal fin lunate, very long and strong, the length of its lobes somewhat greater than depth of

body, its rays 10 + 10 besides basal rudiments, median rays about 1¾ in length of outer rays. No scales preserved.

**64. Ioscion morgani** Jordan, new genus and species.

Plates 8(*a*), 49(*a*).

The backbone of a large fish (No. 541) also from Lompoc, 33 inches long, about 40 if complete, lacks the head and has the fins except the long and strong caudal badly broken.

Body very slender, the depth about 8 times in length. Dorsal rays about X–1, 26, anal about II, 10, the number uncertain.

Vertebræ 15 + 10 = 25, hourglass-shaped, much constricted, extremely long, rather more than twice as long as deep; ribs weakly grooved, rather strong; interspinals slender, all short except the second interhæmal, which is relatively weak; neurals and hæmals rather strong, more so than in Aristoscion eprepes. Dorsal spines high, the longest about 1⅔ in depth of body, a little longer than the longest soft rays, which are also high, anal badly injured, the number of rays uncertain. Caudal large, lunate, its lobes a fourth greater than greatest depth of body, with numerous short rays like fulcra at base. Ventrals and pectorals obliterated.

This species differs from Aristoscion eprepes in the much slenderer body and the much stronger and more constricted vertebræ. In the latter species these are about one-fourth longer than deep. This character of the vertebræ in connection with the elongate body will define the genus Ioscion. The traits of the head, scales and the obliterated paired fins are drawn after living species of Cynoscion.

This species is named for my friend, Dr. Thomas Hunt Morgan of Columbia University.

## Order SCLEROPAREI

### Family XXVI. ANOPLOPOMIDÆ.

#### 65. Eoscorpius primævus Jordan and Gilbert.

EOSCORPIUS PRIMÆVUS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 53, pl. XXX. (Bairdstown.)

The type of this species is a torso, with crushed head and shoulder region and the caudal region wanting. Renewed study of this specimen offers room for question whether the bone lying horizontally below and behind the eye is actually a suborbital stay. Even if so, the fish is assuredly not one of the COTTIDÆ, and the long jaws, sharp, even teeth, small, smooth scales and long, slender, close-set, parallel interspinal bones suggest ANOPLOPOMA. The fish has a many-rayed second dorsal, small, smooth scales, and a large mouth filled with moderate, well-developed, pointed, more or less recurved teeth. Vertebræ about 40, interneurals of second dorsal long and very slender, close-set, the posterior seemingly stouter, though not longer than the anterior. The anal is inserted behind front of the soft dorsal, and its interhæmals are stronger than the interneurals above it. The neurals and hæmals are moderate, and the ribs weak. The vertebræ are longer than deep, somewhat hourglass-shaped. If not related to ANOPLOPOMA it may prove to belong to the SCOMBRIDÆ.

### Family XXVII. SCORPÆNIDÆ.

#### 66. Sebastavus vertebralis Jordan and Gilbert.

Plate 51.

SEBASTAVUS VERTEBRALIS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 50, pl. XXXI, fig. 1. (El Modena.)

This species is known from a young fish, lacking the head and anterior part of the spinous dorsal. With a general resemblance to SEBASTOID forms and especially to the subgenus or genus SEBASTOSOMUS (MELANOPS) this specimen differs strikingly in the presence of 30 vertebræ (instead of 27) and in the larger size of the scales. The anal fin is also longer, its rays about III, 10, the anal spines being small and graduated with feeble interhæmals.

The problem of the relation of latitude or climate to numbers of vertebræ is left a little complicated by the discovery of these Miocene genera. SEBASTAVUS might well be an ancestor of SEBASTOSOMUS (MELANOPS) or of PRIMOSPINA (MYSTINUS), differing mainly in the larger number of vertebræ (30 instead of 27). But RIXATOR, SEBASTOËSSUS, and SEBASTI-

NUS, Miocene groups also, have 25 vertebræ, agreeing in that regard with other groups of primitive forms, SEBASTODES (PAUCISPINIS) and ROSICOLA (PINNIGER). On the whole, it seems most likely that the group sprang from tropical ancestry, with the usual percoid number (24) of vertebræ.

### 67. **Rixator porteousi** Jordan and Gilbert.

Plate 52.

RIXATOR PORTEOUSI Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 33, pl. XXI, not XXII nor XXIII. (Lompoc.)

Of this species, as I now understand it, we have but one example (No. 300), from Lompoc. It is a large Rock Cod with elongate body, large head, prominent lower jaw, and small graduated anal spines. The interneurals are large, dagger-shaped, dilated at base, formed much as in the living genus, SEBASTODES, with which RIXATOR further agrees in the number ($10 + 24 + 1 = 25$) of vertebræ. I am convinced that in our original description, we were in error in assuming that the second anal spine had been broken.

So far as our material shows, the genus RIXATOR is very close to the typical section of SEBASTODES, perhaps not to be separated from it. Its spines are rather stronger, and the interneurals less dilated than in SEBASTODES PAUCISPINIS of the California Coast. The details of the cranium, so important in these fishes, cannot be made out, and the size of the scales is uncertain. It is probable that the Sebastine fishes originated in the North Pacific, perhaps in California, as extremes of the series, SEBASTODES, SEBASTOMUS, SEBASTICHTHYS are wanting in the waters of Japan, where the group is largely represented.

### 68. **Sebastoëssus apostates** Jordan.

Plates 14(*a*), 53.

SEBASTOËSSUS APOSTATES Jordan, "Genera of Fishes," **4**, 571.

The genus SEBASTOËSSUS is allied to the living genus SEBASTODES Gill (S. PAUCISPINIS Ayres), having the same elongate form, the back not arched, and low number of vertebræ (24 besides the small one at base of the hypural). It has, also, in common with all of the SEBASTINÆ, thirteen dorsal spines, as well as three in the anal. In SEBASTOËSSUS the anal spines are small, with the second interhæmal scarcely enlarged. The characters of the head can not be ascertained, but it is probably similar in form to that of SEBASTODES, long and low, with large mouth and projecting lower jaw. SEBASTOËSSUS differs most strikingly from SEBASTODES and RIXATOR in the very slender interneurals and in the shorter interhæmals of the soft anal.

In SEBASTODES the interneurals of the first dorsal are all greatly dilated behind, as long as the strong, straight neurals, the anterior widest, a third as wide as long; the first three coalescent. The interhæmals of the second dorsal are all dilated or dagger-shaped, growing smaller backward. The interhæmals are long, slender, and straight. In SEBASTOËSSUS all the interneurals are slender and sharp, shorter than in SEBASTODES.

In SEBASTODES the two divisions of the hypural are narrower, with a wider space between, this two-thirds the breadth of either half.

The type of the species (No. 368), already briefly noticed under the name of SEBASTOËSSUS APOSTATES, is a well preserved example, the head as usual crushed, the total length 18 inches. Head 3½ in length to base of caudal; depth at front of anal 4⅘; body elongate, the back not at all arched. Dorsal rays XIII, 5 +, the highest (fourth) spine 1¾ in depth of body; the soft rays about 2; the spines all rather slender and not very high.

Interneurals moderate, subequal, separate, very slender throughout, without dilatation behind or at base. Anal rays about III, 8; the number of soft rays not quite certain; interhæmals moderate, except the elongate second which is 2⅙ in head; that is slender and smaller than in SEBASTINUS, about as in SEBASTODES and RIXATOR. Second anal spine relatively small, 1⅔ in depth of body, slender, slightly curved, a little longer than third spine and scarcely longer than the soft rays, which are 2 in depth of body. Insertion of anal scarcely behind that of soft dorsal (last rays of dorsal and anal obliterated in the type example). Pectoral broad, with at least 16 rays; ventral obliterated. Head shown in outline only, apparently rather long and low. Vertebræ 24 + 1, mesially longer than deep, the last one broadly fan-shaped, divided; caudal subtruncate, slightly concave, 1⅕ in depth of body. Interneurals and interhæmals subequal, not dagger-shaped and not extending halfway to backbone. No certain traces of scales.

The species is more slender in form than RIXATOR PORTEOUSI. From the latter it differs, among other features, in the forward insertion of the anal fin, which, as usual in these fishes, is nearly opposite front of soft dorsal. In RIXATOR PORTEOUSI it is under the middle of the latter fin. The fin spines are essentially as in RIXATOR, the second anal spine and its interhæmals not specially enlarged in either genus. The suggestion made in the original description of R. PORTEOUSI that the second anal spine had been broken is doubtless an error. The two specimens, with the very long anal spine (246.243), regarded as the young of that species, are certainly different from R. PORTEOUSI, having, as in SEBASTOËSSUS APOSTATES and SEBASTINUS INEZIÆ, the interneurals all sharp and slender without trace of dilatation. In fact, there are in the diatom beds apparently three distinct

genera or subgenera all closely allied to SEBASTODES proper. These may be distinguished as follows:

*a*. Interneurals all broad and dilated behind, especially at base; anal fin inserted under middle of soft dorsal; second anal spine not enlarged.
  *b*. Interneurals narrower than in SEBASTODES. RIXATOR.
*aa*. Interneurals all slender and sharp, not at all dilated.
  *c*. Second anal spine scarcely enlarged; insertion of anal fin nearly under front of soft dorsal; second interhæmal moderate. SEBASTOËSSUS.
  *cc*. Second anal spine greatly enlarged; its insertion more or less behind that of soft dorsal; second interhæmal bone extremely long and strong. SEBASTINUS.

We find the interneurals broad and dilated in SEBASTOMUS CONSTELLATUS, in SEBASTOSOMUS MYSTINUS, in PTEROPODUS VEXILLARIS and P. CHRYSOMELAS as well as in SEBASTODES PAUCISPINIS and S. GOODEI.

### 69. Sebastinus ineziæ (Jordan and Gilbert).

Plate 54.

RIXATOR INEZIÆ Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 34, pls. XXII, XXIII, figs. 1, 2. (Lompoc.)

SEBASTINUS INEZIÆ Jordan, "Genera of Fishes," **4**, 571, 1920.

The genus SEBASTINUS differs from RIXATOR (type R. PORTEOUSI) in the sharp and slender interneurals and in the great development of the second anal spine, which is about equal in length to the depth of the body above it. The type of this is species (145-B), figured on plate XXIII of our "Fossil Fishes of Lompoc." It is probable that No. 246, figured on the same plate, belongs to the same species, as also 243, figured on plate XXII. That these forms are not the young of R. PORTEOUSI, as at first supposed, is plain from the fact that the type of SEBASTOËSSUS APOSTATES, a large fish, as large as RIXATOR PORTEOUSI, retains the slender interneurals, characteristic of this small fish, which is the type of the genus SEBASTINUS.

The very strong second anal spine and its interhæmal appear also in the section or genus SEBASTOMUS (ROSACEUS, CONSTELLATUS, etc.), but in this group there are 27 vertebræ, and the interneurals are all dilated.

In our restoration of SEBASTINUS INEZIÆ, the pectoral and ventrals are assumed to be about as in the related species, SEBASTODES GOODEI of California, being probably the nearest living form. It is drawn from the type 145-B, which differs from the other two specimens figured, in the apparently more forward insertion of the enlarged second anal spine, which is under the front of the soft dorsal, instead of near the middle of the latter fin. But in both cases it is under the 14th vertebra (11th from the last), and the apparent difference in position may be due to distortion.

Another specimen since received from Lompoc (No. 542) is 17 inches long, in fair preservation. Head 2⅚ in length, depth 4; dorsal rays about XIII, 14; anal rays III, 10. Vertebræ 10 + 15 = 25; form of SEBASTINUS INEZIÆ. Head long and low, lower jaw projecting, the mandible half length of head. Vertebræ moderate, deeply 3-grooved; neurals rather short; ribs slender, moderate; anterior interneurals slender, with very slight trace of dilatation at base; posterior interneurals short, very slender, two to each pair of neurals; second anal spine strong but broken, anal inserted opposite front of short dorsal; second interhæmal very strong, curved, two-thirds depth of body; third interhæmal rather strong, other interhæmals small, close-set. Dorsal spines partly broken, rather slender, not elevated; pectoral long and broad, with 21 rays, two-thirds length of head; ventrals mainly obliterated.

This specimen is larger than the others and shows some new features, but it seems to belong to the same species. Its dorsal spines, about as in No. 246, as figured by Jordan and Gilbert, are weaker than in No. 243. It is possible that two different species are represented among our examples of SEBASTINUS, from Lompoc, in which case No. 542 should be placed with No. 246. Another fine example (No. 549) has the long second anal spine as long as its interhæmal, the third spine also high, but lower.

### 70. **Sebastine** fish, species undetermined.

No. 54 of the Lompoc collection is a broken head and front part of the body of a large fish resembling a SEBASTODES. The head itself is 6⅔ inches in length, long and low, with a strong and protruding jaw, which is about two-thirds its whole length. Ten of the dorsal spines are preserved, and ten vertebræ. The spines are strong, inserted farther forward and closer together than in SEBASTOËSSUS or RIXATOR, the first in front of the gill opening. The interneurals, as in SEBASTOËSSUS, are slender and not dilated, the anterior neurals relatively strong, interhæmals smaller; ribs weak. This fish I am unable to locate, but as the spinous dorsal begins farther forward than in SEBASTODES and its relatives, it probably belongs to a genus as yet undescribed. The interneurals indicate affinity with SEBASTOËSSUS.

### 71. **Rhomarchus ensiger** Jordan and Gilbert.

Plate 55.

RHOMARCHUS ENSIGER Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 51, pl. XXXI, fig. 5. (El Modena.)

The two young fishes on which this species is based belong certainly to the SCORPÆNIDÆ, being near allies of SCORPÆNA. From the most of the species of that genus R. ENSIGER differs in the very strong spines of both dorsal and anal. It is probable that the original number of vertebræ was 10 + 14 = 24, several of the anterior being lost in the type. The

pectorals, ventrals, and soft anal, as well as the scales, have been supplied from related species. For the head we have drawn a non-committal SCORPÆNA. Very likely the species was, in life, ornamented with ridges and fleshy slips, perhaps as in SCORPÆNA GRANDICORNIS Cuv. and Val.

## Family XXVIII. **HEXAGRAMMIDÆ.**

### 72. **Achrestogrammus achrestus** (Jordan and Gilbert).

HEXAGRAMMOS ACHRESTUS Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 52, pl. XXIV, fig. 2. (Lompoc.) Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 36, pl. XIX.

The two examples of this species, both incomplete, differ from the living species, so far as known, in the very slender and sharp interneurals, none of which shows any basal dilatation whatever. This character may serve to define the new genus, ACHRESTOGRAMMUS, the characters of the head and tail of which are still unknown. In ACHRESTOGRAMMUS ACHRESTUS, as in HEXAGRAMMOS, the dorsal fin is medially divided. In this species the slender interneurals are, in general, as long as the neurals, the interhæmals even longer than the hæmals. In HEXAGRAMMOS the stout interneurals are about two-thirds the length of the neurals.

### 73. **Zemiagrammus isistius** Jordan, new genus and species.

Plates 10(*a*), 50.

Type No. 544, 16 inches long, about 18 when living, is a nearly perfect example, lacking only the last vertebræ of the tail, the caudal and the ventral fins.

Head 4⅔, depth 4⅔; dorsal rays XIX, 25, more or less; anal about 25; pectoral rays 23. Vertebræ 25 + 25 + = 50. Form of HEXAGRAMMOS. Head badly broken. Dorsal fin, nearly complete, continuous, the last spines perhaps very slightly shortened, more than ⅔ height of first soft ray, which is 1⅘ in head; anterior spines slender, about as high as the soft rays, a little more than half head; anal inserted under sixth soft ray of dorsal. Vertebræ small, quadrate, deeper than long, smaller than in A. ACHRESTUS; ribs rather slender, straight; neurals long, slender, straight; hæmals more curved; interneurals slender, straight, not at all dilated at base, only about half as long as the neurals; interhæmals similar, much shorter than the hæmals; no scales preserved.

The species is well distinguished from the living forms of HEXAGRAMMOS, abundant from central California to Alaska, by the higher and scarcely notched dorsal. In this respect it agrees with the Alaskan genus, PLEUROGRAMMUS, from which it is further separated by the simple interneurals, which are much more slender and not all dilated, and also rather

longer than in HEXAGRAMMOS. The vertebræ are relatively more elongate than in the living species, the number being about the same. The interneurals in the species of HEXAGRAMMOS and PLEUROGRAMMUS examined are all winged or dilated at base, this character being most marked under the spinous dorsal, growing weak under the last soft rays. The genus ZEMIAGRAMMUS is characterized by the short and very slender interneurals and interhæmals, and by the continuous dorsal fins.

In our drawing, the head, caudal fin, scales, and lateral lines are drawn from the living species of the California coast, HEXAGRAMMOS SUPERCILIOSUS (Pallas).

## Family XXIX. **OPHIODONTIDÆ.**

### 74. **Ophiodon ozymandias** Jordan, new specific name.

OZYMANDIAS GILBERTI Jordan, "Fossil Fishes, Lompoc," p. 36, pl. XXIV, 1920. (Lompoc.) (Not of Jordan, "Fossil Fishes S. Cal.," p. 44, pl. XXI, 1919.)

The segment of a large fish (No. 332), provisionally, but no doubt incorrectly, identified by us as OZYMANDIAS, agrees in essential respects with the living genus, OPHIODON Girard, the Blue Cod of the shores of California. It is without much doubt a new species in or near that genus. OPHIODON ELONGATUS Girard is the only living representative of the family of OPHIODONTIDÆ, a near ally of the HEXAGRAMMIDÆ.

## Family XXX. **COTTIDÆ(?).**

### 75. **Hayia daulica** Jordan and Gilbert.

HAYIA DAULICA Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 55, pl. XXIII, fig. 2. (Los Angeles Miocene shales.)

The type of this species is the crushed anterior region of a large fish, of which the most important structures are broken or confused. There is no trace of any of the fins, the spinous dorsal excepted. This has 7 or 8 rather strong but low spines, well spaced, and strong interneurals which are not dilated and are as long as the strong neurals. The vertebræ are quadrate, rather deeper than long. The bones of the jaws, the maxillaries, one premaxillary, and part of the mandible being preserved have a mackerel-like look, the maxillary being about 3½ times in head. The roughness of the bones in the opercular region suggested to us the Cottoid genus ASPICOTTUS, but this appearance may be illusive. I can, however, think of no genus more nearly related, but better material may show the fish to be a mackerel, though the vertebræ seem too large for that group. In any event it is very distinct from EOSCORPIUS and from all the genera either of COTTIDÆ or SCOMBRIDÆ, yet known.

## Suborder GOBIOIDEA

### Family XXXI. GOBIIDÆ.

#### 76. Aboma antiqua Jordan and Gilbert.

Plate 56.

ABOMA ANTIQUA Jordan and Gilbert, "Fossil Fishes S. Cal.," p. 36, pl. XXIX, fig. 1. (Bairdstown.)

This little goby seems very similar to living species, and the presence of about eight dorsal spines indicates that it should be placed in the existing genus, ABOMA, represented by several species in Mexico and in Japan. The figure must be substantially correct, although the anal fin is lost in the type, and the head somewhat injured. In the type, the upper rays of the caudal are longer than the lower, but this character may be fallacious.

## Suborder XENOPTERYGII

### Family XXXII. GOBIESOCIDÆ(?).

#### 77. Bulbiceps raninus Jordan.

BULBICEPS RANINUS Jordan, "Fossil Fishes S. Cal.," p. 12, pl. VI. (Soledad Pass.)

This peculiar little fish is known from two impressions in the Soledad sandstone, each about two inches long. The general appearance is that of a tadpole. The large size of the head is no doubt partly due to pressure, but it must have been nearly as long as the rest of the body, and at least half as deep as long. The genus was doubtfully referred to the LIPARIDÆ, but the few vertebræ, not more than 24 to 26 at the most, makes this reference highly unlikely. It may be placed provisionally with the GOBIESOCIDÆ, a group well represented in the present California fauna. These have 24 to 26 vertebræ, but none of the living Cling-fishes has a forked caudal, as BULBICEPS seems certainly to have.

Our plate (6, above) is a very close copy of the type as it now appears.

## Suborder BLENNIOIDEA

### Family XXXIII. ZAPRORIDÆ(?).

#### 78. Aræosteus rothi Jordan and Gilbert.

Plate 49(*b*).

ARÆOSTEUS ROTHI Jordan and Gilbert, "Fossil Fishes, Lompoc," p. 27, pl. XIV. (Lompoc.)

The type of this species is much damaged, the head being crushed and the caudal region lost. The general form, with the make-up of the dorsal fin, is precisely as in the rare fish of Vancouver Island, ZAPRORA

SILENUS. We have, therefore, ventured to restore head, scales, and the missing fins to correspond to that species. Neither the type specimen, nor the crushed specimen (No. 11, plate XXIII, fig. 3, "Fossil Fishes S. Cal.") shows any feature by which ARÆOSTEUS can be separated from ZAPRORA. The relations of ZAPRORA are still undetermined. The genus is most likely blennioid, related, though remotely, to ANARRHICHADIDÆ.

# APPENDIX

## THE DIATOMS OF THE LOMPOC BEDS.

I have sent samples of the Lompoc material for study to Dr. Albert Mann of the Carnegie Institution at Washington. The following letter, dated Washington, March 17, 1920, explains itself. This should be read in connection with Dr. Mann's first letter, printed in our "Fossil Fishes of Diatom Beds of Lompoc, California," p. 6.

Your sample from Lompoc at the PLECTRITES CLASSENI level turns out to be very interesting. It contains a much larger number of species than the other strata. A list is given at the end of this letter. Practically all the forms are characteristic of northern waters; in fact, the Lompoc diatoms are, as a class, clearly brought down from northern latitudes. There are fewer of the plankton species, THALASSIOTHRIX FRAUENFELDII Grun., in this material than in the others sent by you. You will remember it was especially abundant in the XYNE GREX layer. Sponge spicules are very abundant in this new sample. Like the other layers, the diatoms are free from clay and other mineral detritus and show no wear from transportation; they also agree in being wholly, or almost wholly, pelagic forms.

I neglected to tell you that, in regard to the suggestions I made on the origin of the Lompoc diatoms and the physical causes resulting in the slaughter of the herring, two things should be understood: (1) My remarks were only suggestions drawn from incomplete facts, not declarations based on conclusive evidence. With this in mind, I shall be glad to have you make any use of my letters you choose. (2) These ideas were derived solely from a study of the material, independent of statements in your book or elsewhere. I have made it a rule in approaching a problem of this sort to draw my conclusions from a study of the material alone, and afterward to read what others have said on the subject.

In conformity with this method, I did not read your excellent book until after I had sent you my report. I am pleased to find that my remarks agree so well with the general view of the case presented by you and by Dr. Frank M. Anderson, resting as they do upon a much more comprehensive study of the facts.

Since writing to you I have received a report from Dr. Frank Rabak (Dept. Agriculture) on the physical characteristics of the diatom oil, the chemical analysis of which I have already furnished you. It is as follows:

Color, dark green.
Odor, strong, fish-like.
Sp. Gr. at 25° C., 0.9762.
Acid value, 135.1.
Saponification val., 222.4.
Iodine value, 137.3.
Unsaponifiable, 34.9.

The above approximate analysis would show that the oil is related to certain animal oils, since the acid value and saponification of such oils are usually high. The saponification value of brown fish oil is 224.8; of Porpoise (jaw) oil, 254.0; of Dolphin (jaw) oil, 290.0. The iodine value places it in a class with the fish oils,

such as Menhaden, which has an iodin value of 139–173; of Herring oil, 135–142; and of Sardine oil, 121–187. A high percentage of unsaponifiable matter is also found, which is probably cholesterol.

An excellent nucleus exists in this oil for a valuable contribution to the knowledge of marine or related oils.

Mr. Rabak adds: "It would appear from the results obtained to have little relation to petroleum." This remark seems to me hardly significant, as, on account of the changes through which petroleum must have passed, one would not expect a close similarity between it and the substance from which it was derived.

I did not attempt a full study of all forms in the earlier samples you sent me, because you stated that Mr. Porteous was engaged on that work. I have, however, studied the PLECTRITES layer more carefully and have found the following species:

ACTINOCYCLUS EHRENBERGII Ralfs, var. intermedia Grun., frequent.
ACTINOPTYCHUS UNDULATUS E., common.
ACTINOPTYCHUS VULGARIS Schum., very scarce.
BIDDULPHIA AURITA Breb., scarce.
BIDDULPHIA WEISSFLOGII Jan., scarce.
CHÆTOCEROS AFFINE Laud., not frequent.
CHÆTOCEROS sp.?, scarce.
CLADOGRAMMA CALIFORNICUM E., frequent.
COCCONEIS GREVILLEI W. S., scarce.
COCCONEIS DIRUPTA Greg., scarce.
COCCONEIS OCULUS-CATI Br., very scarce.
COSCINODISCUS APICULATUS E., common.
COSCINODISCUS BOREALIS Bail (nec E.), very common.
COSCINODISCUS DECIPIENS Grain., not frequent.
COSCINODISCUS ELEGANS Grev., scarce.
COSCINODISCUS EXCENTRICUS E., not frequent.
COSCINODISCUS LEPTOPUS Grun., common (var. of C. LINEATUS E.).
COSCINODISCUS LINEATUS E., common.
COSCINODISCUS MARGINATUS E., very common.
COSCINODISCUS MINOR E., frequent.
COSCINODISCUS PRÆTEXTUS Jan., very scarce.
COSCINODISCUS SUBTILIS E., scarce.
COSCINODISCUS SYMBOLOPHORUS Grun., common.
COSCINODISCUS WOODWARDII Eul., very common.
DIMEREGRAMMA, new species, very scarce.
GONIOTHECIUM ROGERSII E., very scarce.
GRAMMATOPHORA LYRATA Grun., var., very scarce.
GRAMMATOPHORA SERPENTINA Ralfs, very scarce.
HEMIAULUS POLYMORPHUS Grun., frequent.
HEMIDISCUS CUNEIFORMIS Wall., frequent.
LITHODESMIUM CALIFORNICUM Grun. (var. of L. UNDULATUM E.), frequent.
MELIOSIRA SULCATA K., not frequent.
MELIOSIRA CLAVIGERA Grun., scarce.
NAVICULA ÆSTIVA Donk., var., scarce.
NAVICULA, new species, scarce.
RAPHONEIS GEMMIFERA E., common.
RHIZOSOLENIA HEBETATA Bail., not frequent.
STEPHANOPYXIS APPENDICULATUS (E.) Grun., scarce.
STEPHANOPYXIS(?) ARISTATA T. and Br., common.

STEPHANOPYXIS CORONA (E.) Grun., scarce.
STEPHANOPYXIS GRUNOWII Gr. and St., frequent.
STEPHANOPYXIS PEDIASTRIFORMIS Forti, frequent.
STICTODISCUS CALIFORNICUS Grev., var., scarce.
THALASSIOSIRA NORDENSKJOLDII Cl., frequent.
THALASSIOTHRIX FRAUENFELDII Grun., common.
THALASSIOTHRIX NITZSCHIOIDES (Grun.) V. H., frequent.
XANTHIOPYXIS OBLONGUS E., frequent.
XANTHIOPYXIS sp. frequent.
ENDOCYSTS of different varieties, bearing such names as DICLADIA CAPREOLUS E., PERIPTERA TETRACLADIA E., etc.

The terms above denoting relative abundance form the following arbitrary scale: (1) very common, (2) common, (3) frequent, (4) not frequent, (5) scarce, (6) very scarce.

One diatom that is frequent in the XYNE GREX layer does not seem to occur in the PLECTRITES material—ASTEROMPHALUS BEAUMONTII E. It is a strictly pelagic species.

The CHÆTOCEROS sp. and XANTHIOPYXIS sp. are not new, but I have not fixed their identification. There are two new species, a NAVICULA and a DIMEREGRAMMA. When I find time to photograph these I will name them.

On material sent later, taken from the shales about individual fossils, Dr. Mann, under date of October 9, 1920, gives the following notes:

The layer containing remains of a flounder (EVESTHES HOOVERI) can hardly be called "diatomaceous"; the diatoms are certainly less than 1/10 of 1%. It is a mineral layer, chiefly calcium carbonate freely effervescing with HCl, the residue being quartz silt, i. e., microscopic sand. Here and there is a marine sponge spicule. It therefore seems to be bottom silt preserved in connection with the flounder. The diatoms noted were mostly bottom forms, mixed with some plankton:

ACTINOPTYCHUS UNDULATUS E.
COSCINODISCUS EXCENTRICUS E.
C. OBSCURUS A. S.(?)
C. WOODWARDII Eul.
C. CURVATULUS var. LATIUS-STRIATA A. S. (A doubtful var. in Schmidt's Atlas 57/34.)
C. OCULUS-IRIDIS E.
C. DECRESCENS Grun.
C. MARGINATUS E.
C. APICULATUS E.
C. LINEATUS E.
C. NODULIFER A. S. (HEMIAULUS POLYMORPHUS Grun.)
HYALODISCUS STELLIGER Bail.
MELOSIRA SULCATA K.
THALASSIOTHRIX NITZSCHIOIDES Grun. (very common).
RAPHONEIS AMPHICEROS E.
XANTHIOPYXIS sp. (doubtful).

The sample marked "SEBATOESSUS APOSTATES" was hardly distinguishable from the run of Lompoc material. The THALASSIOTHRIX FRAUENFELDII Grun., with many distorted individuals so common in Lompoc bed, was here plentiful; also COSCIONODISCUS LINEATUS E., HEMIDISCUS CUNEIFORMIS Wall.; STEPHANOPYXIS APPENDICULATUS E.; and less common, ACTINOCYCLUS EHRENBERGII Ralfs, COSCINODISCUS ROBUS-

TUS Grev, C. WOODWARDII Eul., C. ASTEROMPHALUS E., C. CONVEXA A. S. (Schmidt's Atlas 60/15?), C. FULGURALIS Br., C. SUBTILIS E., C. OBSCURUS A. S., C. SYMBOLOPHORUS Grun., C. RADIATUS E., C. OCULUS-IRIDIS E., ACTINOPTYCHUS UNDULATUS E., THALASSIOTHRIX NITZSCHIOIDES Grun., DENTICULA VALIDA Grun., RAPHONEIS AMPHICEROS E., ASTEROMPHALUS BEAUMONTII E. (the var. called A. DARWINII E.), HEMIAULUS POLYMORPHA Grun., CLADOGRAMMA CALIFORNICUM E., THALASSOSIRA NORDSKJOLDII Cl., DICLADIA CAPREOLUS E. (CHÆTOCEROS sp.), DIMEREGRAMMA MINOR Greg. (wide var.), BIDDULPHIA SEPARANDA Jan. (in Schmidt's Atlas 141/27, which is only a var. of B. WEISSFLOGII Jan. and is not a true BIDDULPHIA at all).

A small sample of laminated diatom earth, marked merely "From a thin deposit," is probably the purest diatom material you have so far sent me; snowy white, loosely compacted, and absolutely free from foreign matter, except an occasional marine sponge-spicule. The species do not differ from those characteristic of the bed as a whole.

The brown stony concretion, containing borings of a Pholas-like mollusk, is not at all diatomaceous. It appears to be a slate resulting from fine argillaceous mud. It is unaffected by boiling acids. The adjacent diatom layer has a great preponderance of that pelagic diatom, THALASSIOTHRIX FRAUENFELDII Grun., common in Lompoc material.

In addition to the material above noted I sent also a mass of soft rock of a deep red color, strongly laminated, the strata being very narrow, and containing rounded balls of the size of small peas, looking like fish eggs. It is possible that this mass is composed of volcanic dust. As to this, Dr. Mann observes:

The red layer containing round white bodies like fish eggs is unlike anything else you have submitted. The percentage of diatoms in the red matrix is very low. It is in no sense a diatom earth. There are merely traces of broken forms common to the adjacent diatom layers, as COSCINODISCUS CURVATULUS Grun., C. ROBUSTUS Grev., etc.

The material seems to be argillaceous, with no calcium or other carbonates. It does not disintegrate with HCl or $HNO_3$. I have no idea what causes the red color, except that it is *not* iron. The white spots are inclosures of diatom earth. This disposes of the idea of anything like fish-eggs; for, as I understand it, infiltration of mineral matter in solution may replace a closed organic structure, but not solid particles like diatoms.

The species are few, and thereby the material contrasted with the average Lompoc deposit, are principally COSCINODISCUS SUBTILIS E., C. SYMBOLOPHORUS Grun., and the doubtful variety of C. ROBUSTUS Grev. figured in Schmidt's Atlas 62/17 from Monterey, Cal.

The material about DIATOMŒCA ZATIMA is about the usual Lompoc diatom flora, but with a higher per cent of THALASSIOTHRIX FRAUENFELDII Grun. than is generally present.

IOSCION MORGANI is somewhat unusual. About 60% is THALASSIOTHRIX FRAUENFELDII ( a little above the average), but COSCINODISCUS BOREALIS Bail, a generally abundant species, is here not at all frequent, while C. WOODWARDII Eul., C. OCULUS-IRIDIS E., and CLADOGRAMMA CALIFORNICUS Grun. are strikingly plentiful, and HEMIAULUS CUNEIFORMIS Wall, that is generally rare, although well distributed through the layers, is here in great abundance. I should add that COSCINODISCUS LINEATUS E. is also conspicuously plentiful.

The ECLIPES MANNII layer is still more contrasting. I give the following sp. observed, and will mark with an asterisk (*)some that I either have not come across in other samples or else are excessively rare in them.

ACTINOPTYCHUS BIFRONS* Br. (probably a var. of A. STELLA A. S.)
A. UNDULATUS E.
ASTEROMPHALUS DARWINII E.
ARACHNOIDISCUS ORNATUS* E.
AULACODISCUS DECORUS* Grev. (var. A. STOSCHII Jan.).
BIDDULPHIA LONGISPINA* A. Grun.
B. TUOMEYII Bail.
CLADOGRAMMA CALIFORNICUM Grun.
COCCONEIS DIRUPTA Greg.
C. GREVILLEI W. S. Grun.
COSCINODISCUS APICULATUS E.
C. BOREALIS Bail.
C. DEVIUS* A. S.
C. ELEGANS Grev.
C. EXCENTRICUS E.
C. FULGURALIS Br.
C. JANISCHII A. S., var. ARAFURENSIS Jan.
C. LINEATUS E.
C. NORMANII* Grev.
C. OCULUS-IRIDIS E.
C. RADIATUS E.
C. RADIOSUS* Grun.
C. ROTHII (E.) Grun.
C. SUBTILIS E.
C. SYMBOLOPHORUS Grun.
C. WOODWARDII Eul.
C. sp.* in Schm. Atlas, 57/29 misnamed.
C. n. s. resembling "C. FUSCUS" Norm.
C. n. s. (remotely like C. EXCENTRICUS E.; occurs in other layers).
GONIOTHECIUM ROGERSII E. (an endocyst).
GRAMMATOPHORA MARINA K.
G. MAXIMA Grun.
HEMIAULUS POLYMORPHUS Grun.
LITHODESMIUM CALIFORNICUM Grun.
L. MINUSCULUM* Grun.
MASTOGLOIA (ORTHONEIS) SPLENDIDA* (Greg.) Mann.
MELOSIRA SULCATA K.
NAVICULA LYRA* E.
NITZSCHIA INSIGNIS* Greg.
PYXILLA AMERICANA* (E.) Grun.
RHABDONEMA JAPONICUM T. and B.
RHAPHONEIS AMPHICEROS E.
STEPHANOPYXIS TURRIS (Grev.) Ralfs.
STICTODISCUS CALIFORNICUS, var. ECOSTATA* Grun.
THALASSIOTHRIX FRAUENFELDII Grun.
T. NITZSCHIOIDES Grun.
TRIGONIUM AMERICANUM* (Bail) Cl.
T. CONDECORUM* (E.) Cl.

T. ARCTICUM* Cl.
XANTHIOPYXIS UMBONATUS* Grev.

By glancing over the list you will see that so many are unusual in the average run of Lompoc material that this layer is well marked from the others. Is it adjacent to some of the other layers of which you have sent samples?

As suggested, this comes from a different level, the diatomic rocks much heavier, being subjected to much greater pressure, although without extraneous or inorganic matter. "There is a hint of this," Dr. Mann observes, "in the more broken condition of the diatoms about IOSCION MORGANI and ECLIPES MANNII."

Dr. Mann continues:

To give a complete list, other than those contained in former letters, would require a careful reëxamination of all the specimens sent. You will recall that when I examined these I stated that an authentic list of all the Lompoc diatoms was beyond the time at my disposal and that the lists were indicative only of the prevalent species in each gathering. I understand Mr. G. Dallas Hanna is attempting a thorough study of the Lompoc bed, which, if he is successful, will take him several months to accomplish. I believe this great deposit ought to have such attention and would amply repay the labor. But as a lone diatomist, vainly trying to cover the earth, I dare not just now go further than I have gone.

I am indebted to Mr. Edward J. Porteous for the accompanying plates showing species of diatoms and Radiolaria.

In a paper entitled "The Diatomaceous Earth of Lompoc, Santa Barbara County, California" (*Geological Magazine*, **58**, 271–277, June, 1920), Sir Nicholas Yermoloff gives a list of the diatoms obtained by him from a slab containing XYNE GREX, sent by Mr. Arthur H. Krieger to the British Museum through Mr. J. L. Bosqui.

This list contains 85 species, of which only 21 are included under the same name in the lists of Dr. Mann. The latter contain 90 names, which would appear to be only a small fraction of the diatom wealth of Lompoc. Much of this apparent discrepancy seems to arise from differences in nomenclature.

Yermoloff observes:

The genera, DICTYOCHA, EUODIA, COSCINODISCUS, and THALASSIONERNA (THALASSIOTHRIX) dominate and give to the deposit its characteristic facies. It has undoubtedly a more northern facies than, say, the deposit from Los Angeles, which contains many more southern forms. The abundance of the DICTYOCHA and EUODIA (HEMIDISCUS) is indeed the most remarkable feature in the Lompoc deposit.

# LIST OF ILLUSTRATIONS

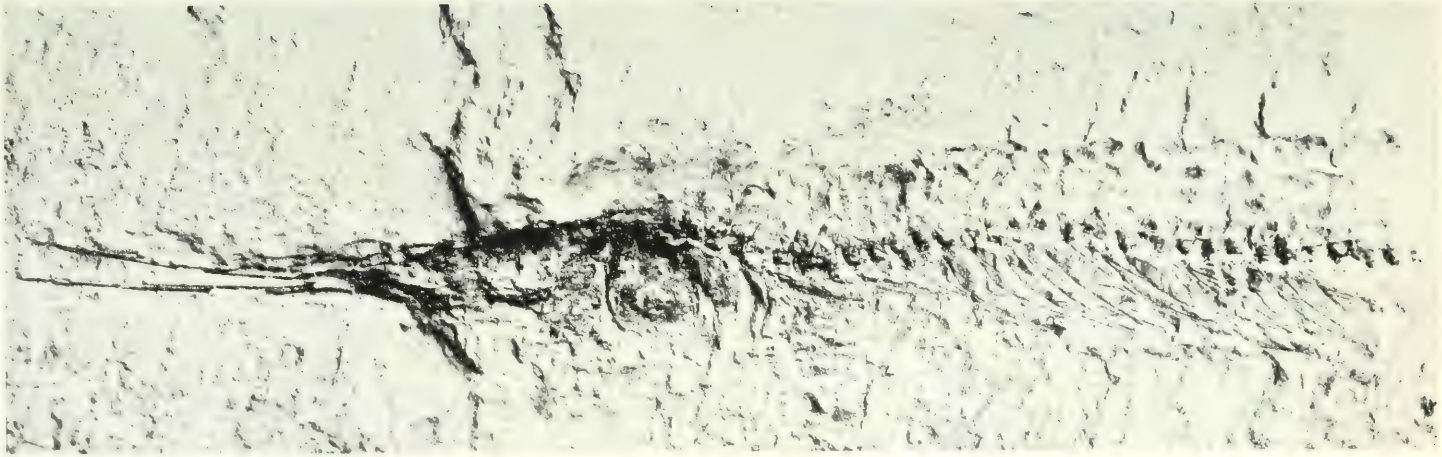


## RESTORATIONS.

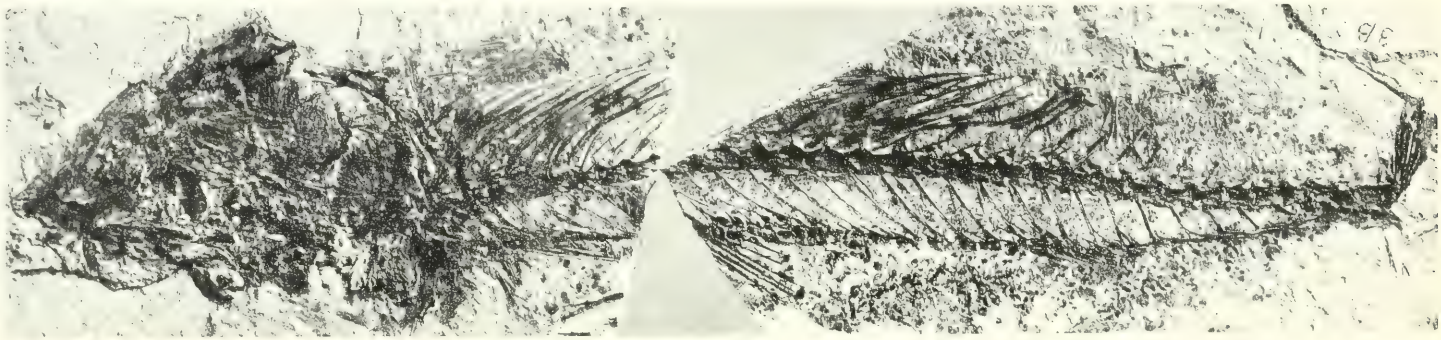
26. (*a*) ZELOTES ALHAMBRÆ Jordan.
    (*b*) ZELOSIS HADLEYI (Jordan and Gilbert).
27. (*a*) SCOMBERESSUS ACUTILLUS (Jordan and Gilbert).
    (*b*) ALISEA GRANDIS Jordan and Gilbert.
28. (*a*) TROSSULUS EXOLETUS Jordan.
    (*b*) SYNGNATHUS AVUS Jordan and Gilbert.
29. ZANTECLITES HUBBSI Jordan and Gilbert.
30. (*a*) ARNOLDINA INIISTIA Jordan and Gilbert.
    (*b*) DEPRANDUS LESTES Jordan and Gilbert.
31. (*a*) ECLIPES MANNI Jordan.
    (*b*) ECLIPES VETERNUS Jordan and Gilbert.
32. DIATOMŒCA ZATIMA Jordan and Gilbert.
33. ZORORHOMBUS VELIGER Jordan.
34. EVESTHES JORDANI Gilbert.
35. EVESTHES HOOVERI Jordan.
36. (*a*) AUXIDES DASSON Jordan.
    (*b*) THYRSOCLES KRIEGERI (Jordan and Gilbert).
37. TURIO WILBURI Jordan and Gilbert.
38. (*a*) ZAPHLEGES LONGURIO Jordan.
    (*b*) OCYSTIAS SAGITTA Jordan.
39. TUNITA OCTAVIA Jordan and Gilbert.
40. SERIOLA SANCTÆ-BARBARÆ Jordan.
41. (*a*) ATKINSONELLA STRIGILIS Jordan.
    (*b*) LOMPOCHITES HOPKINSI Jordan.
42. ERITIMA EVIDES Jordan and Gilbert.
43. EMMACHÆRE RHOMALEA Jordan.
44. RHYTHMIAS STARRII Jordan and Gilbert.
45. PLECTRITES CLASSENI Jordan.
46. NEOMÆNIS HAGARI (Jordan and Gilbert).
47. LOMPOQUIA RETROPES Jordan and Gilbert.
48. ARISTOSCION EPREPES Jordan.
49. (*a*) IOSCION MORGANI Jordan.
    (*b*) ARÆOSTEUS ROTHI Jordan and Gilbert.
50. ZEMIAGRAMMUS ISISTIUS Jordan.
51. SEBASTAVUS VERTEBRALIS Jordan and Gilbert.
52. RIXATOR PORTEOUSI Jordan and Gilbert.
53. SEBASTOËSSUS APOSTATES Jordan.
54. SEBASTINUS INEZIÆ (Jordan).
55. RHOMARCHUS ENSIGER Jordan and Gilbert.
56. Diatoms (photographs and identifications by E. J. Porteous):
    (*a*) COSCINODISCUS BOREALIS.
    (*b*) ACTINOCYCLUS EHRENBERGI.
    (*c*) ARACHNOIDISCUS ORNATUS.
    (*d*) ACTINOPTYCHUS UNDULATUS.
    (*e*) STEPHANOPYXIS CORONA.
57. Radiolarians (photograph by E. J. Porteous. Left to right:
    (*a*) PERIPHANIA DECORA.
    (*b*) PODOCYRTIS CENTRISCUS.
    (*c*) EUCYRTIDIUM ELEGANS.
    (*d*) EUCYRTIDIUM SIPHO.
    (*e*) STYLOSPHŒRA CORONATA.
    (*f*) SPERIGOSPHŒRA PACHYSTYLA.
    (*g*) PODOCYRTIS MITRELLA.

Diatom Beds, Sierra Santa Ynez, Lompoc.

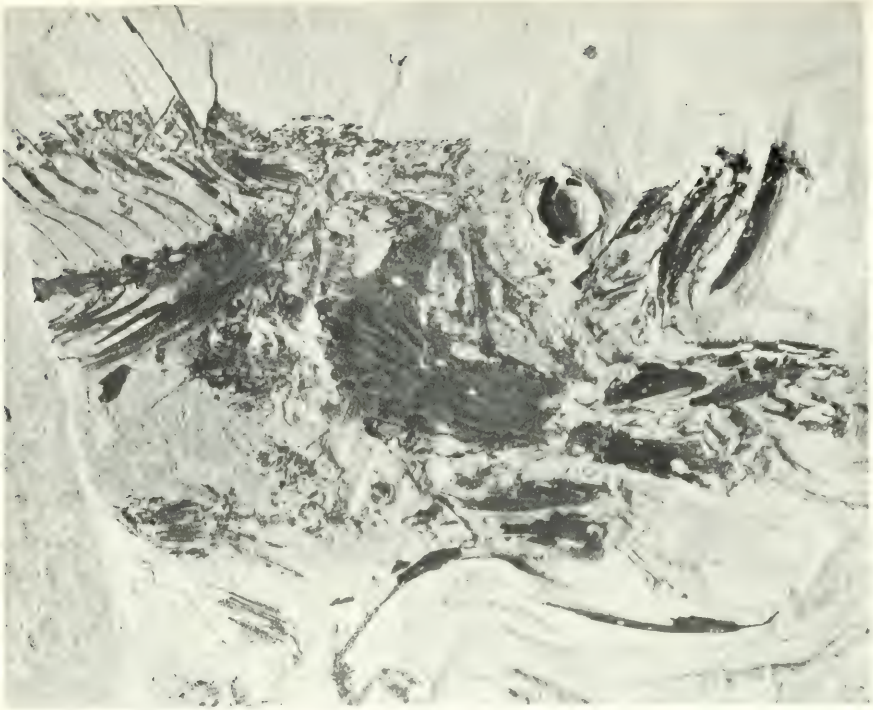
Cuttings in Diatom Beds, Lompoc.



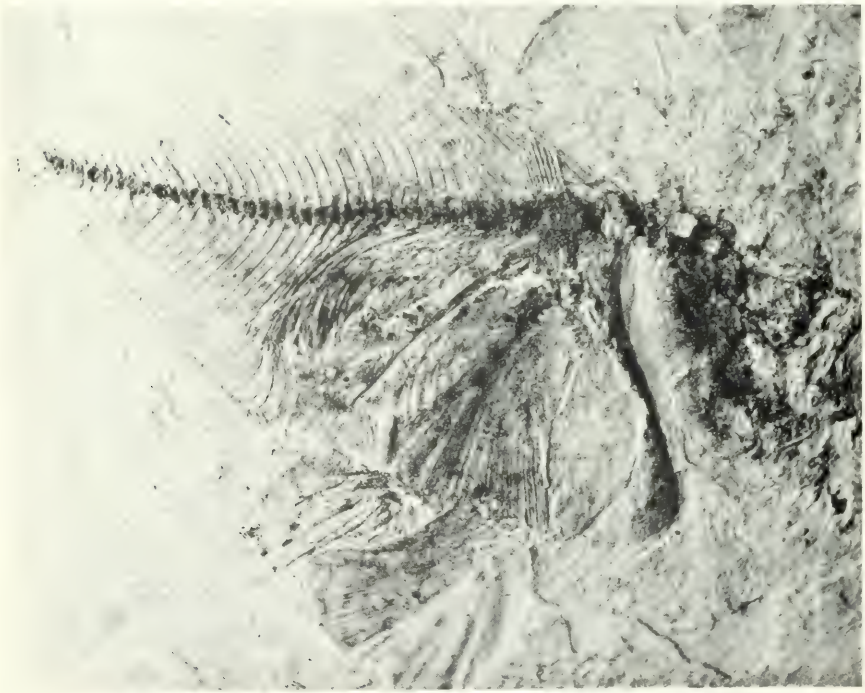
(*a*) Beltion peronides Jordan; type No. 52, Lompoc.



(*b*) Auxides dasson Jordan; types Nos. 66 and 67, El Modena.

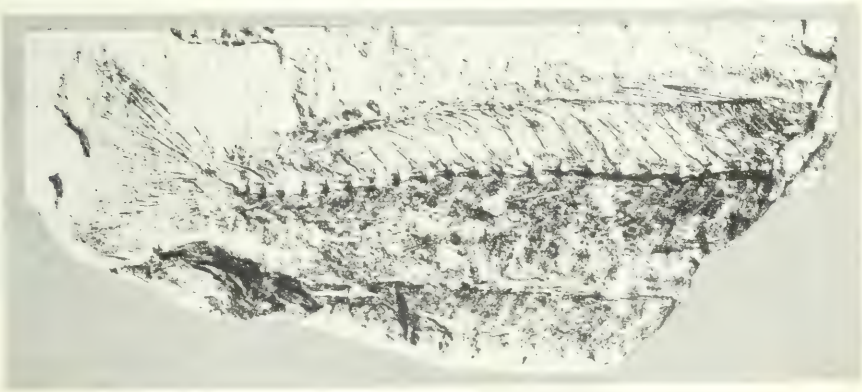


(*a*) Xestias iratus Jordan; type No. 222, Lompoc.

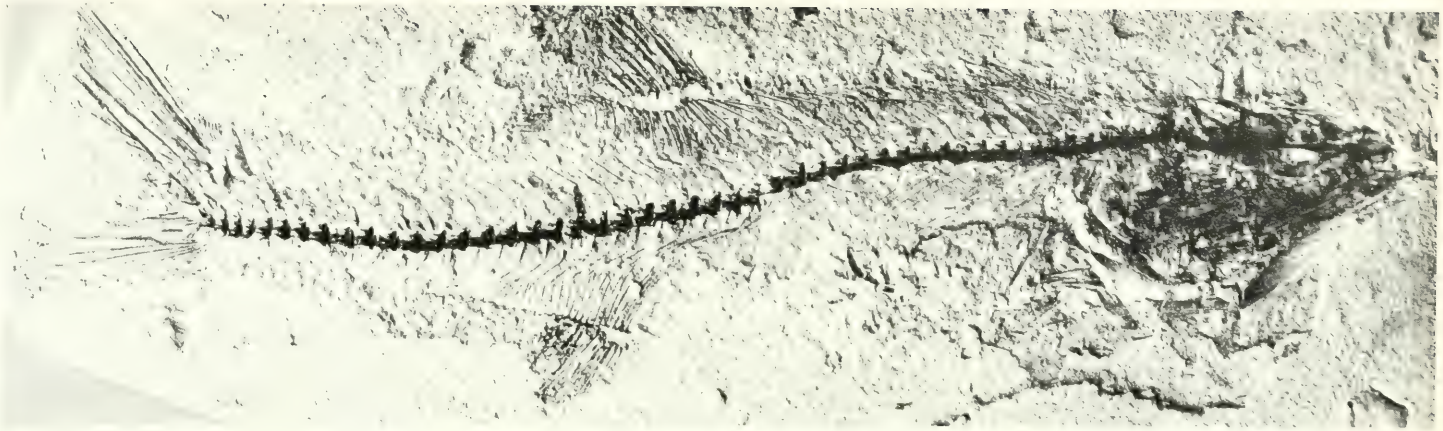


(*b*) Diatomœca zatima Jordan and Gilbert; No. 600, Lompoc.

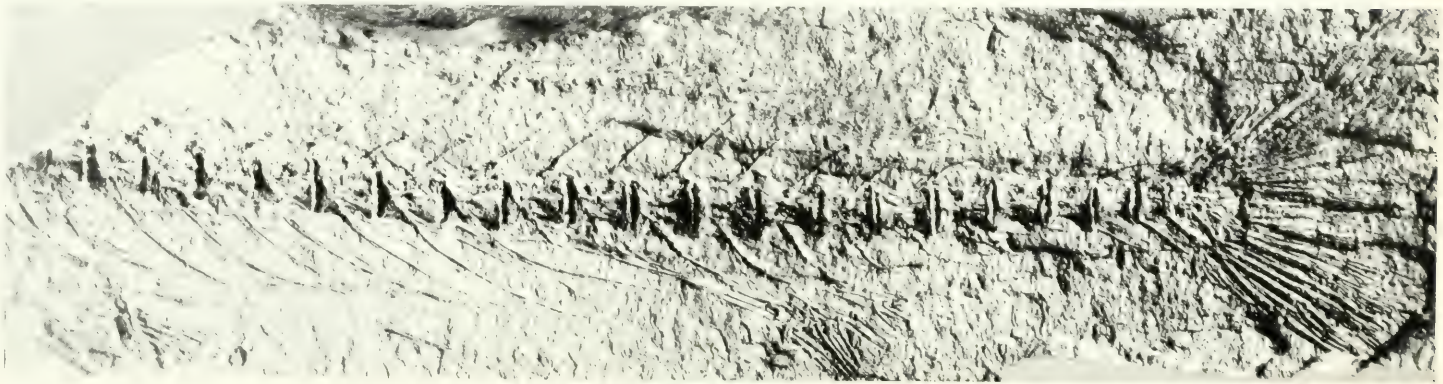
(*a*) Shoulder girdle of LAMPRIS REGIUS Bonnaterre.



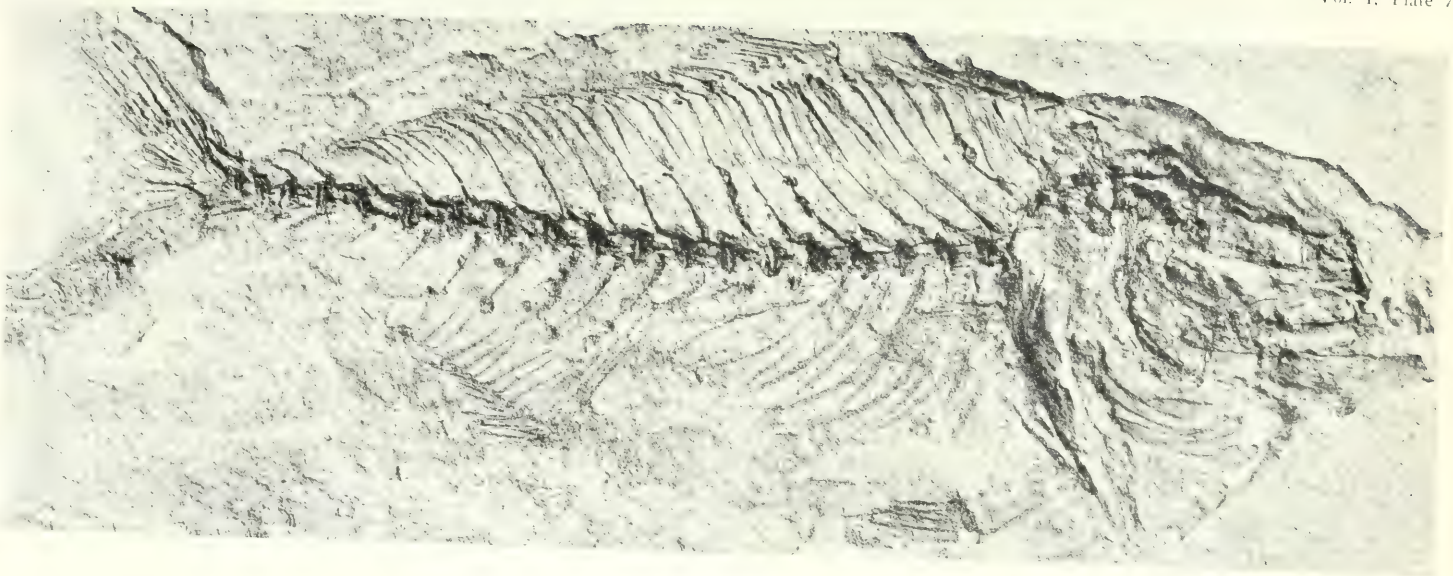
(*b*) ATKINSONELLA STRIGILIS Jordan; No. 511 A, Lompoc.



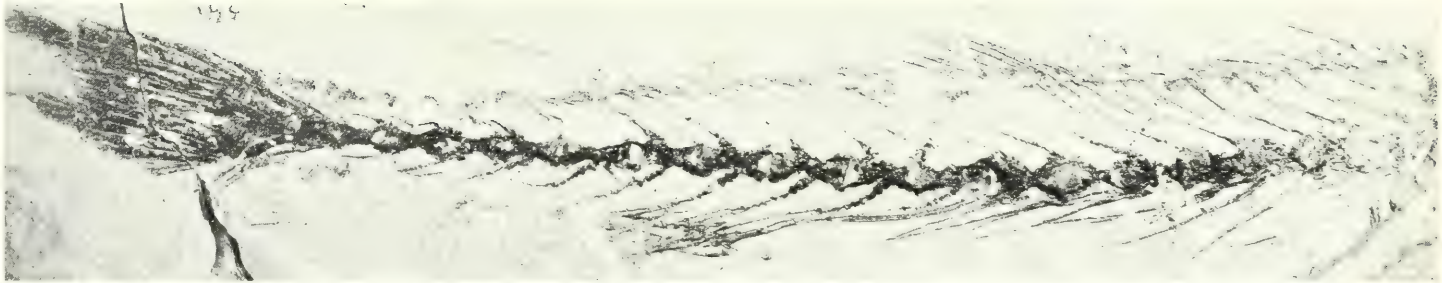
(*a*) THYRSOCLES VELOX (Jordan); No. 153, Lompoc.



(*b*) ARISTOSCION EPREPES Jordan; type No. 522, Lompoc.

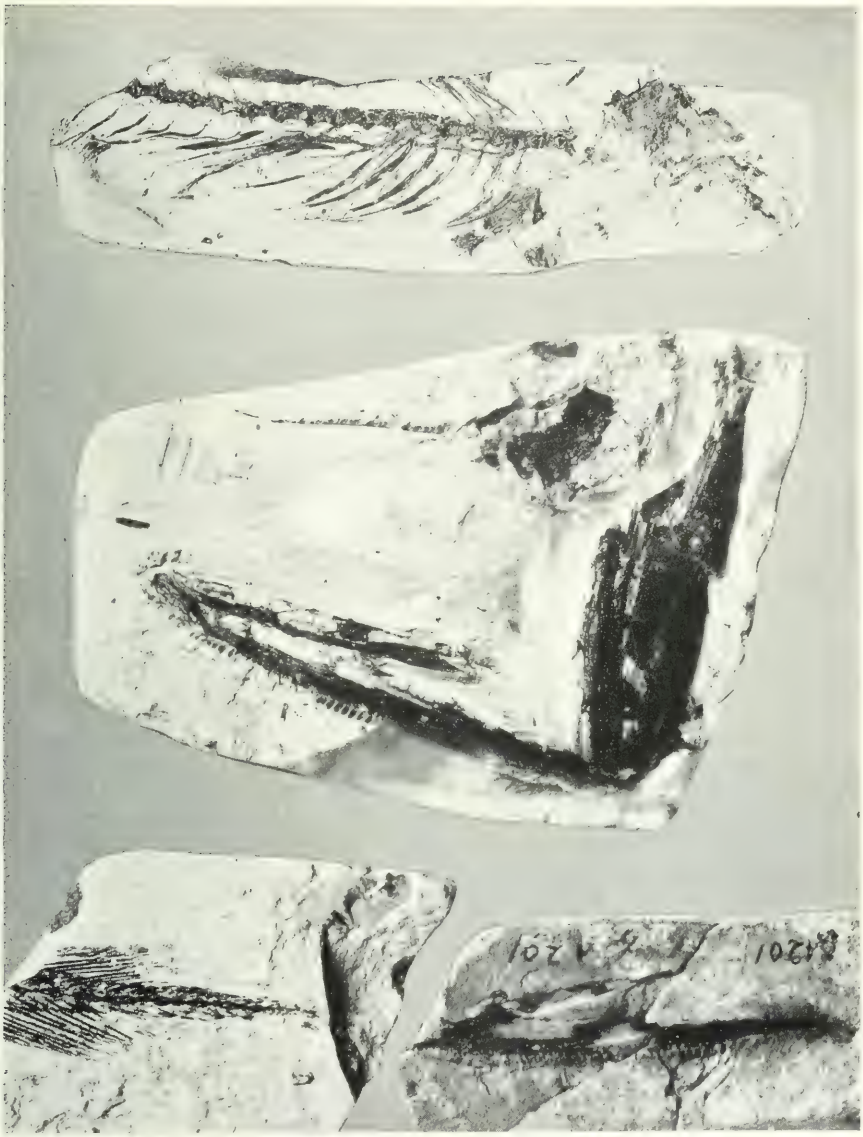


SERIOLA SANCTÆ-BARBARÆ Jordan; type No. 62, Lompoc.

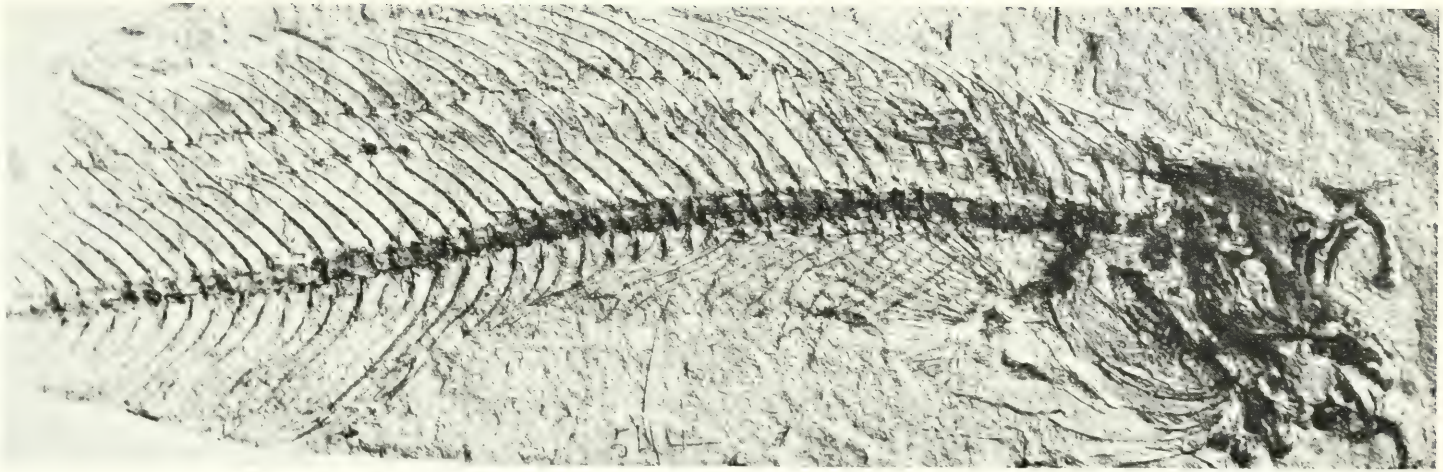


(*a*) Ioscion morgani Jordan; type No. 541, Lompoc.

(*b*) Quisque gilberti Jordan; type No. 18, El Modena. (*c*) Trossulus exoletus Jordan; type No. 548, Lompoc.

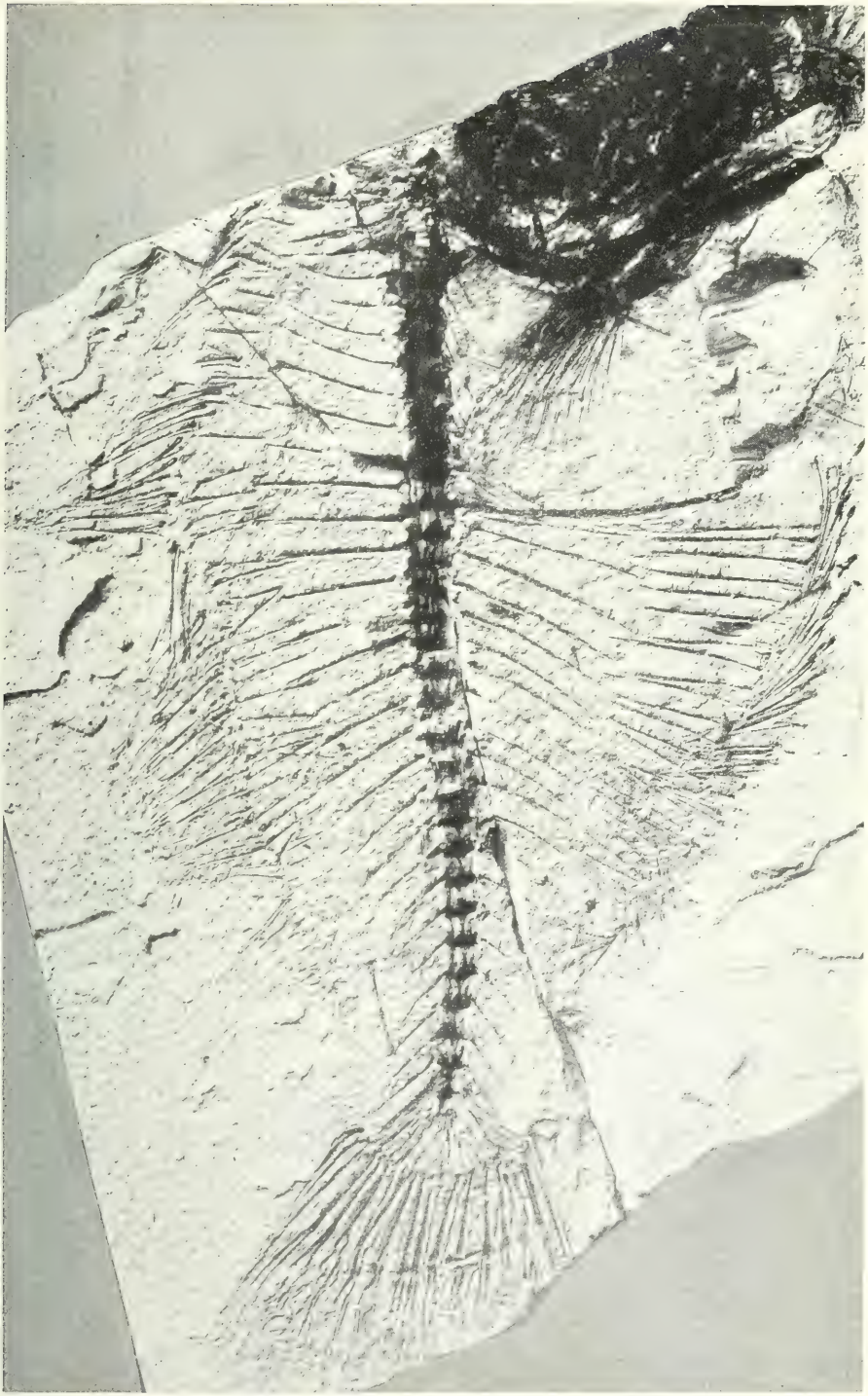


(*a*) Auxides bruntoni Jordan; type No. 68, El Modena.
(*b*) Deprandus lestes Jordan and Gilbert; No. 571, Alhambra.
(*c*) Eclipes extensus Jordan; type No. 716, Alhambra
(*d*) Deprandus species, Alhambra.



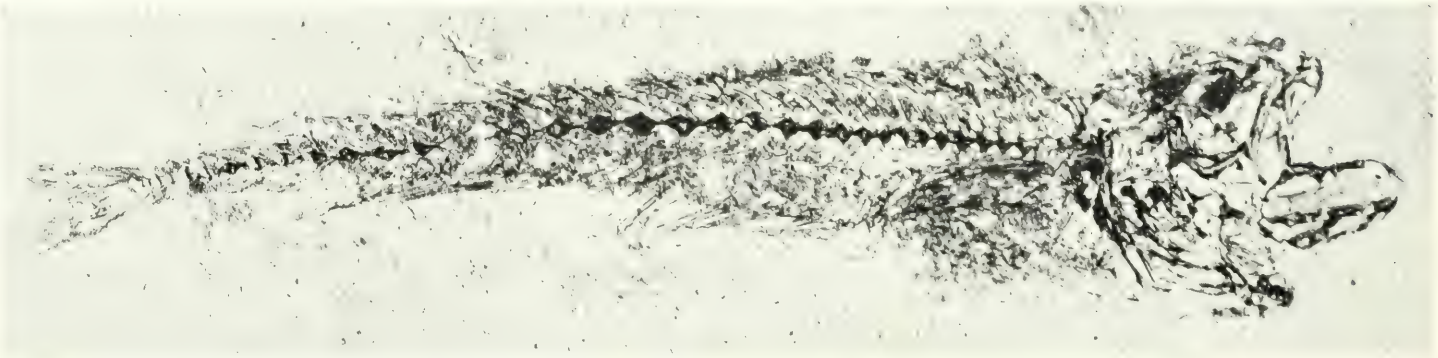
(*a*) ZEMIAGRAMMUS ISISTIUS Jordan; type No. 544, Lompoc.

(*b*) LESTICHTHYS PORTEOUSI Jordan; type No. 220, Lompoc.

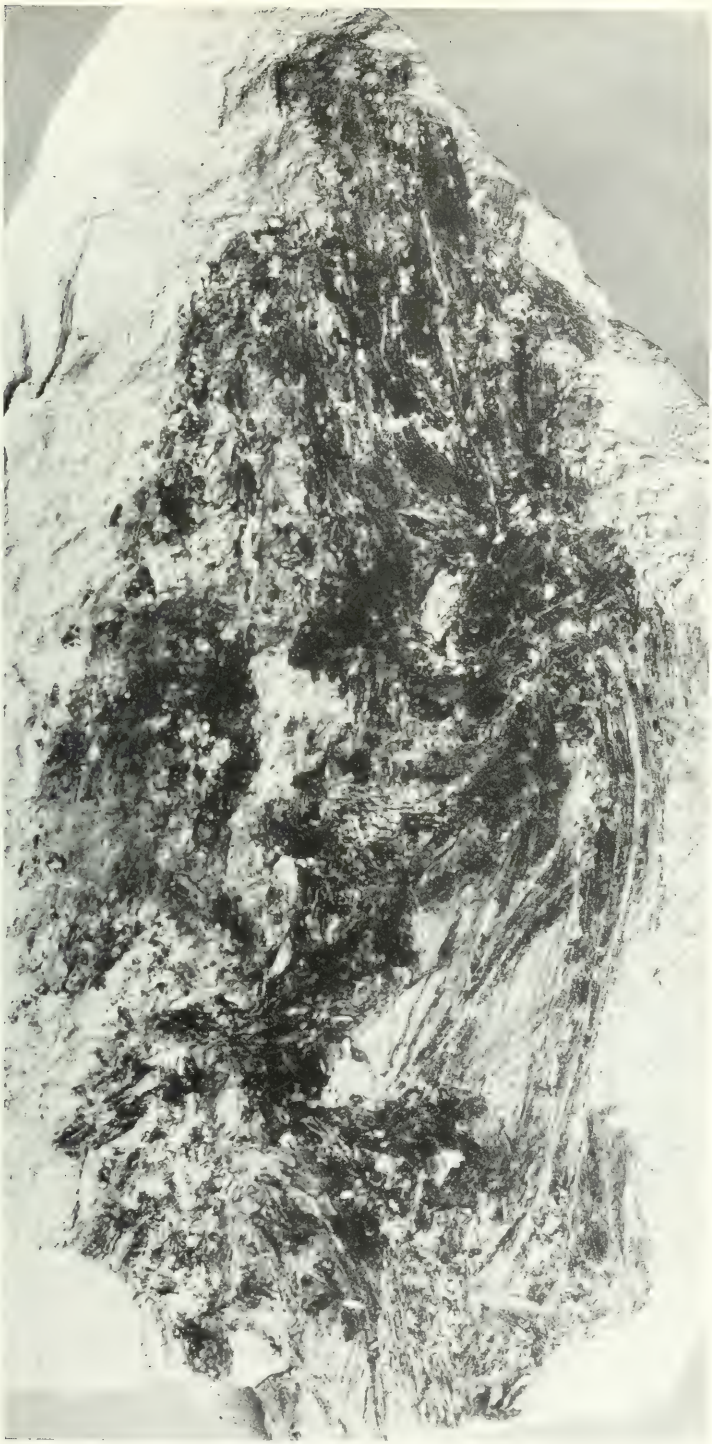


EVESTHES HOOVERI Jordan; No. 53, Lompoc.

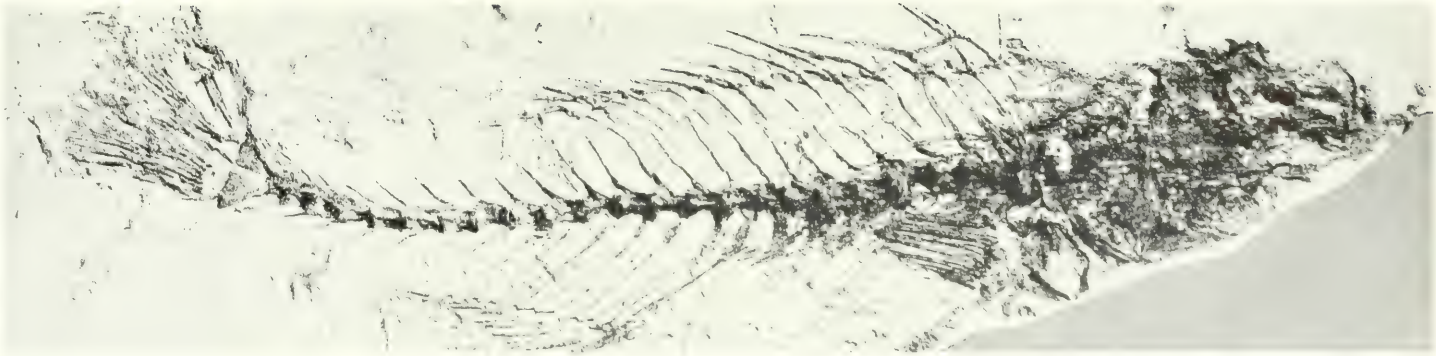
(*a*) ZELOTES ALHAMBRE Jordan; type No. 23c, Alhambra.



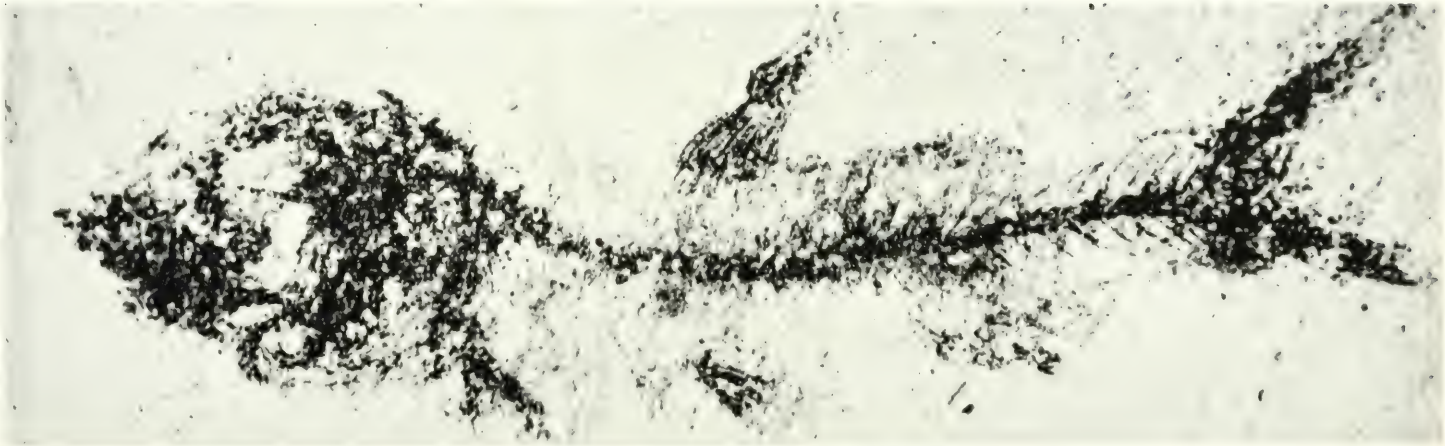
(*b*) ECLIPES MANNI Jordan; type No. 543, Lomboc.



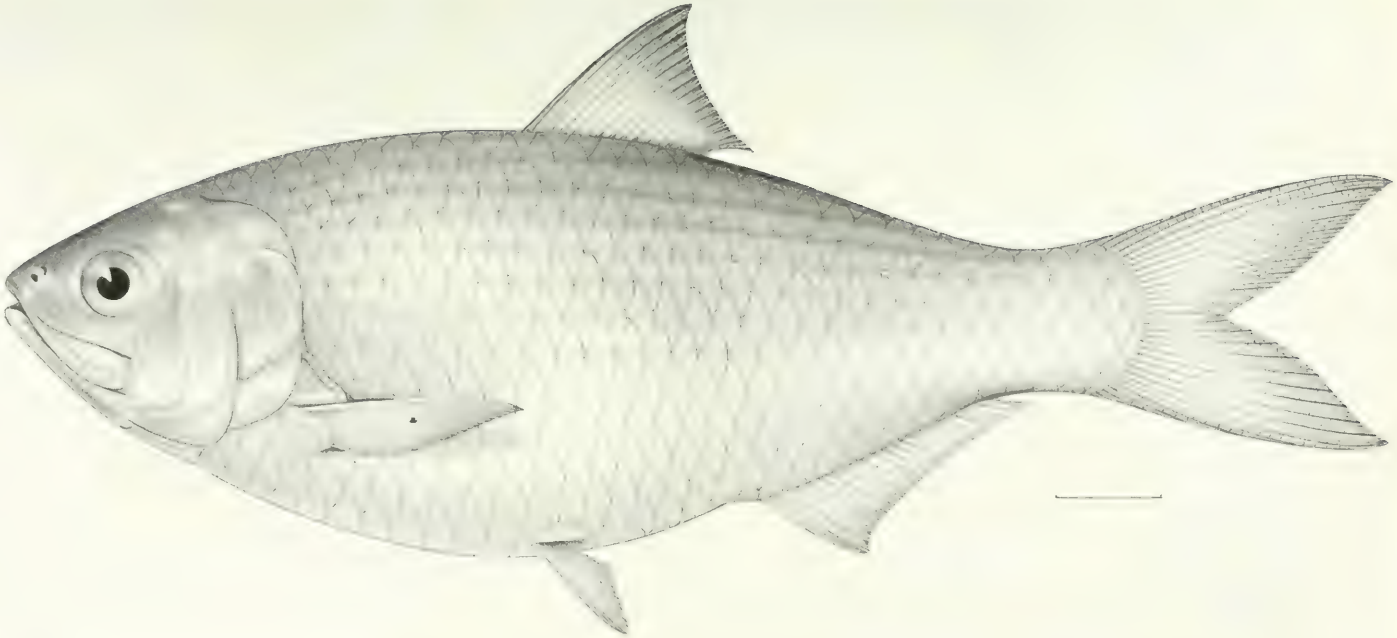
Skull, supposed to belong to OZYMANDIAS GILBERTI Jordan; No. 332, Lompoc.



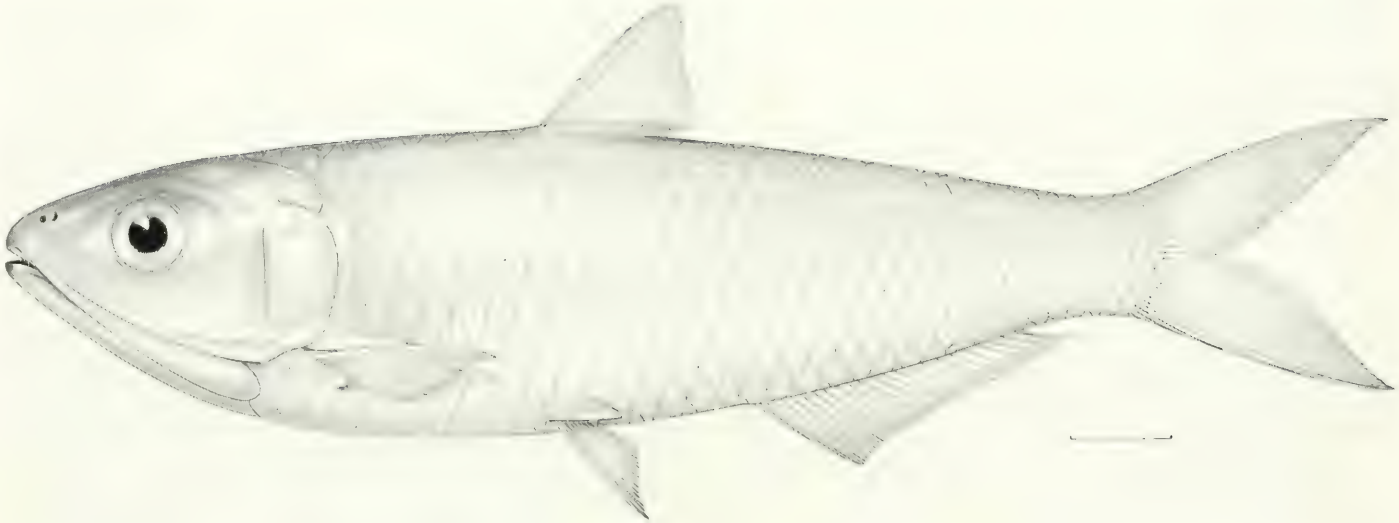
(a) Sebastodes apostatus Jordan; type No. 368, Lompoc.



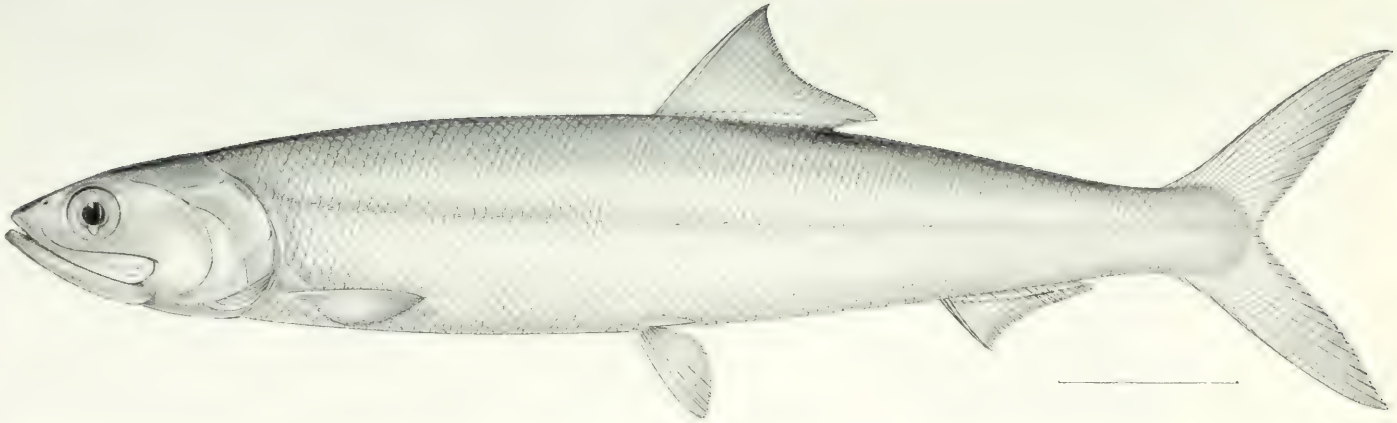
(b) Quæsita fragilis Jordan; type No. 110, San Pedro Hills.



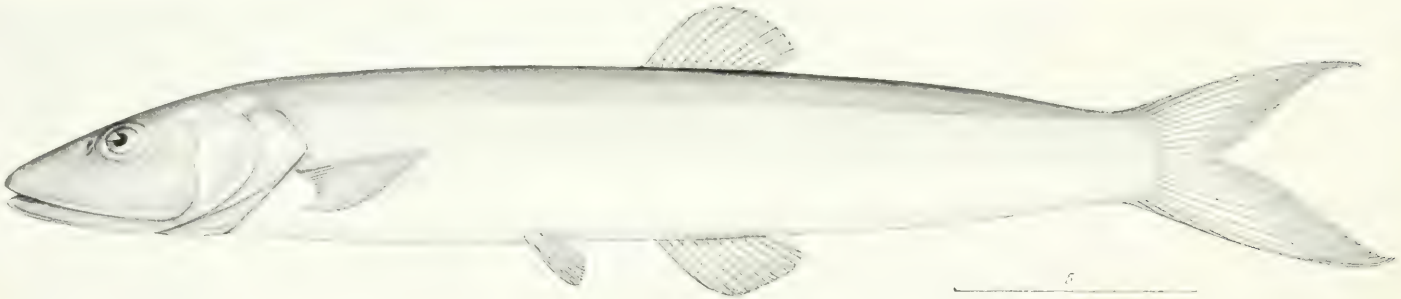
GANOLYTES CAMEO Jordan.



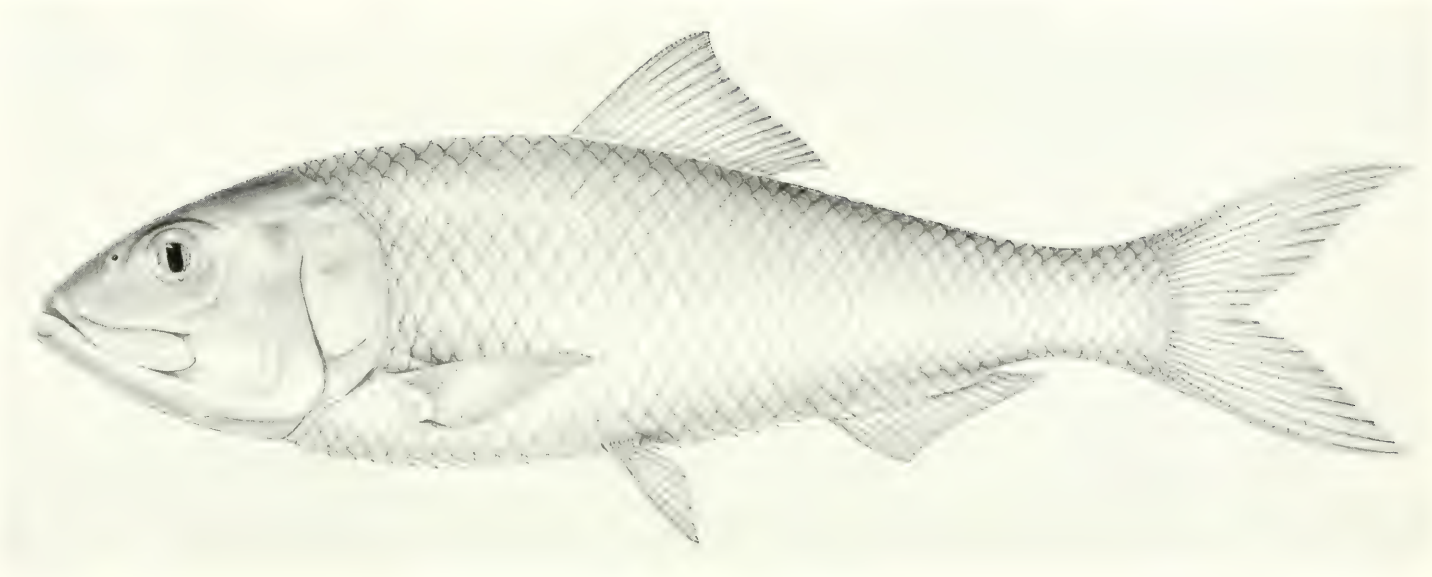
GANOLESUS CLEPSYDRA Jordan.



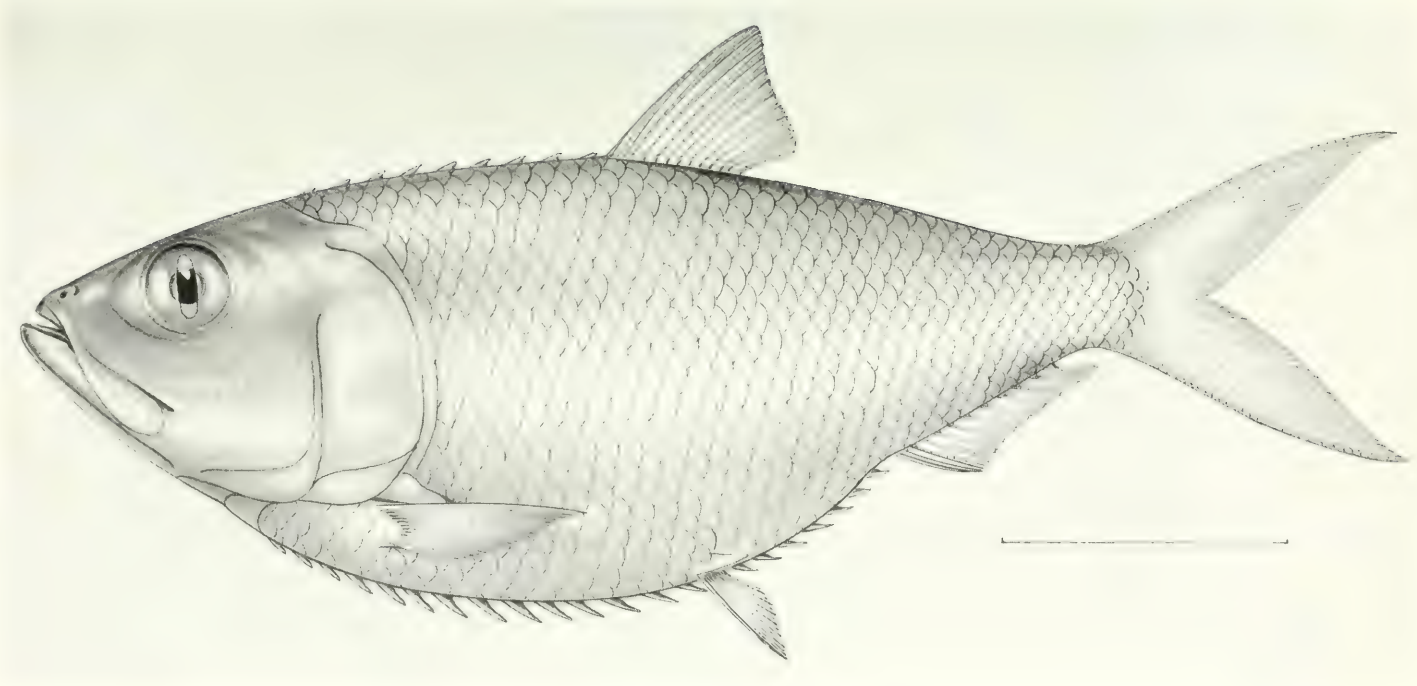
(*a*) Ectasis proriger Jordan and Gilbert.



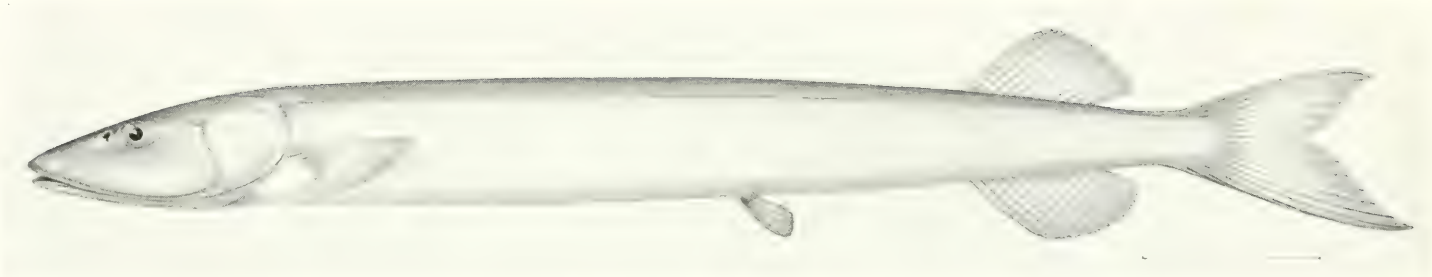
(*b*) Rogenio solitudinis Jordan.



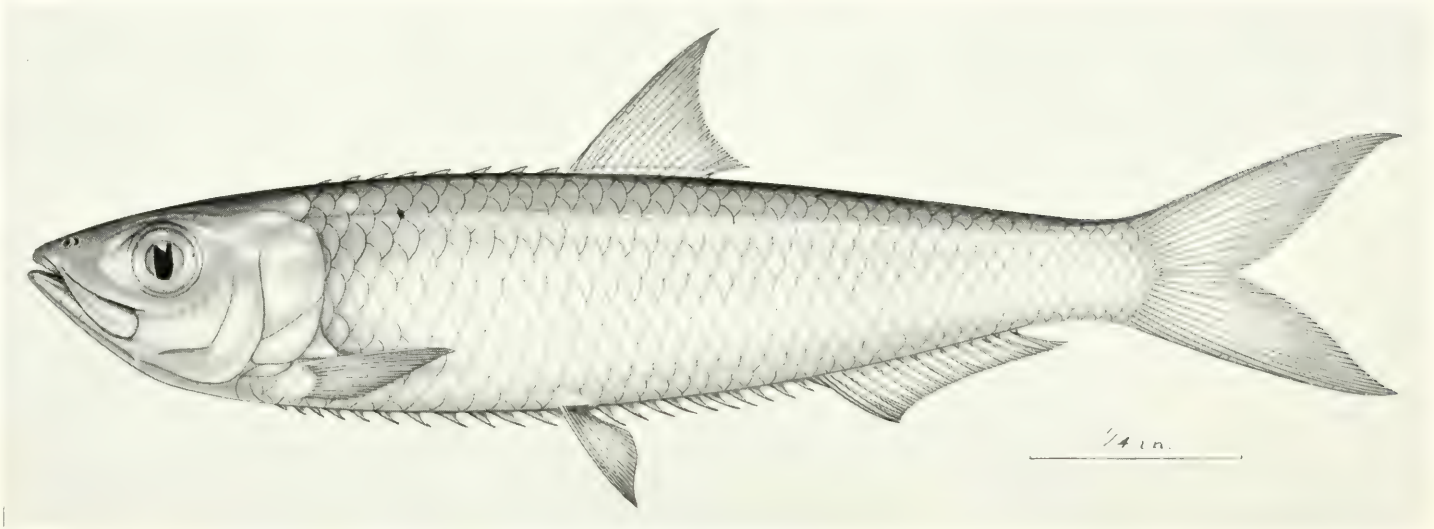
NYNE GRIN Jordan and Gilbert



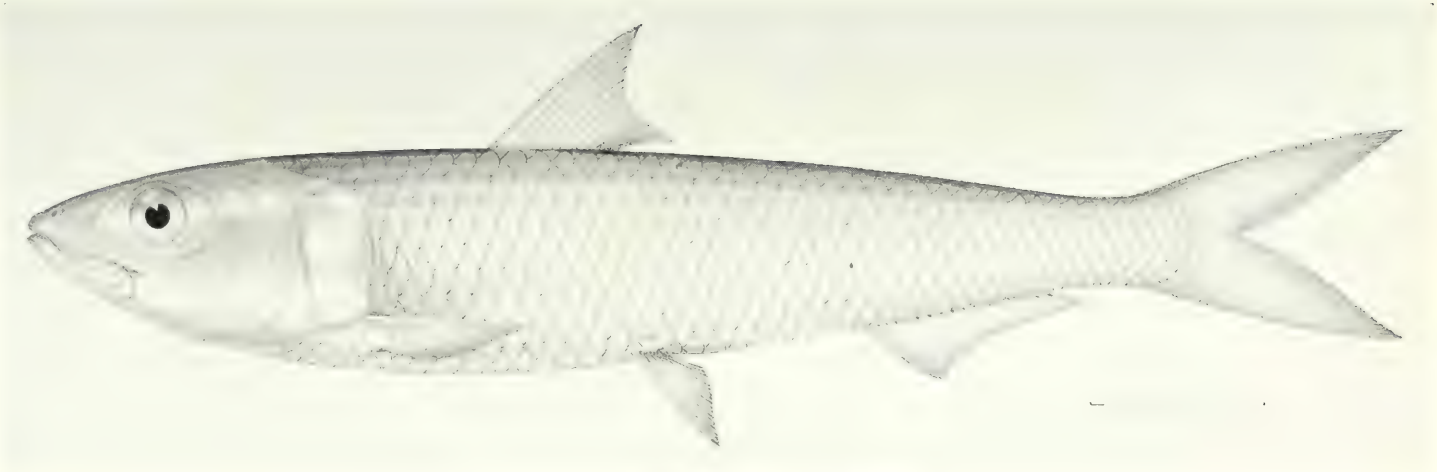
XYRINIUS ELMODENÆ (Jordan and Gilbert).



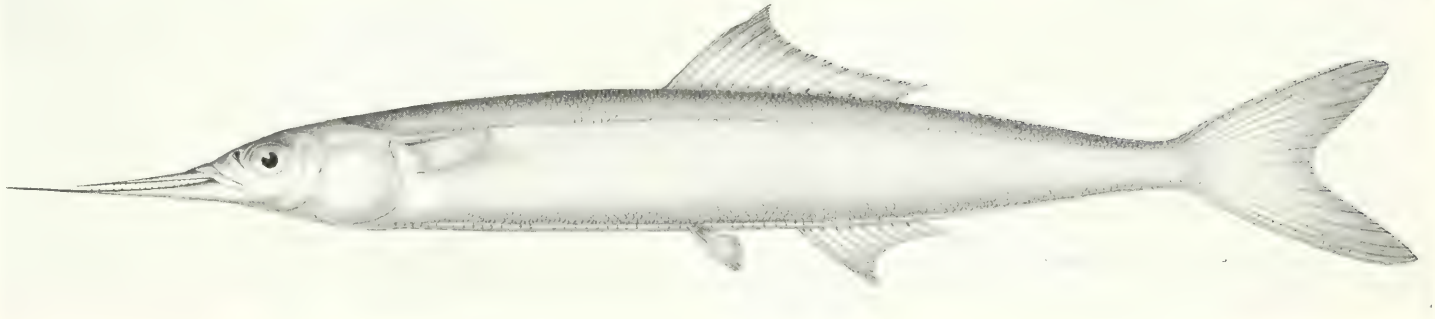
(*a*) ROGENITES BOWERSI (Jordan).



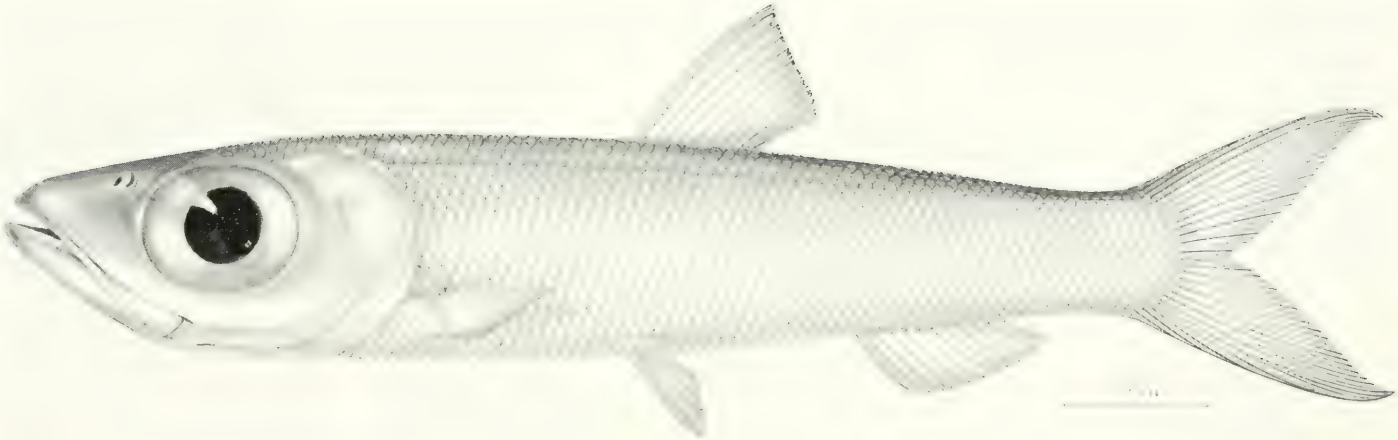

(*b*) QUISQUE GILBERTI Jordan.



(*a*) LYGISMA TENAX Jordan and Gilbert.



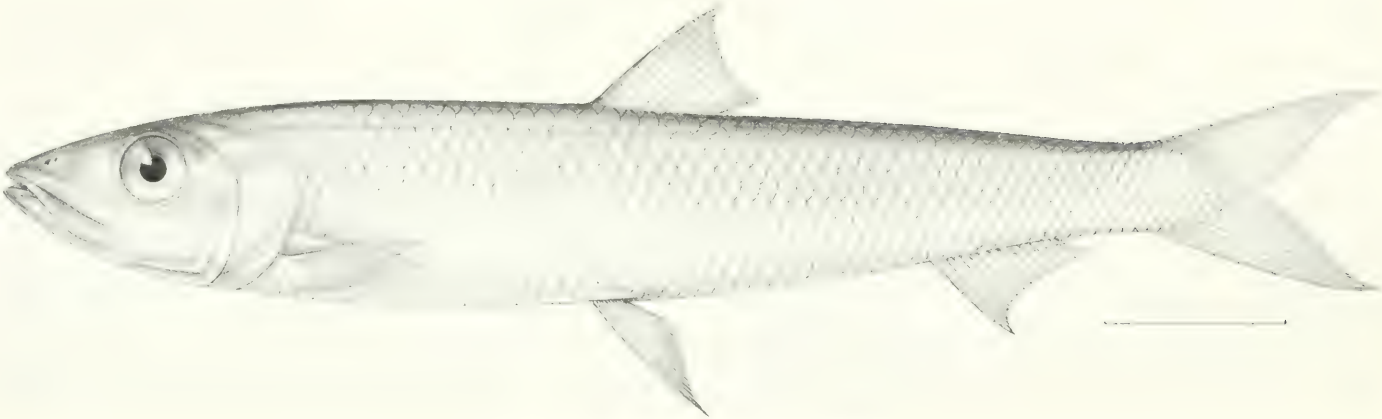
(*b*) FORFEX HYPURALIS Jordan.



(*a*) QUESITA QUISQUILIA Jordan and Gilbert.

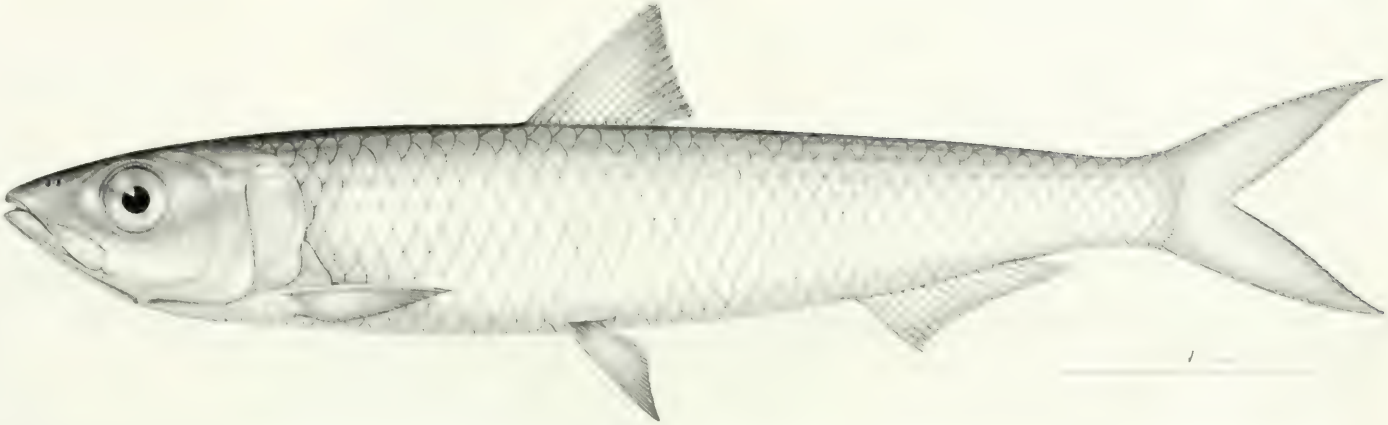
(*b*) LESTICHTHYS PORTEOUSI Jordan.

(*a*) AZALOIS ANGELENSIS Jordan and Gilbert.

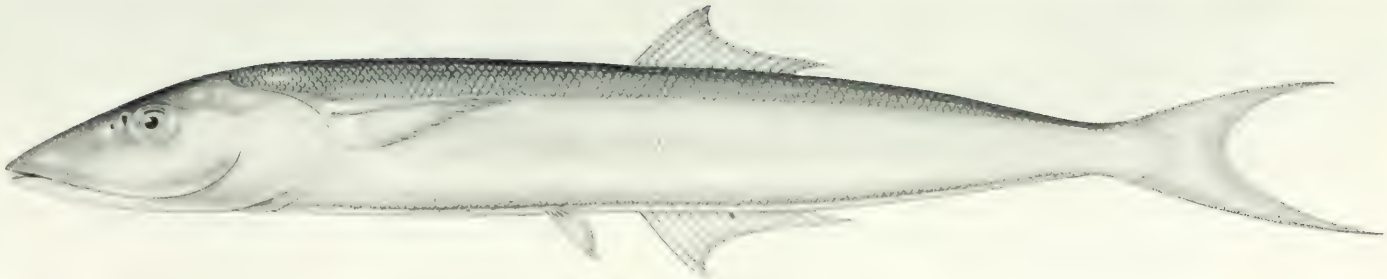


(*b*) QUÆSITA FRAGILIS Jordan and Gilbert.

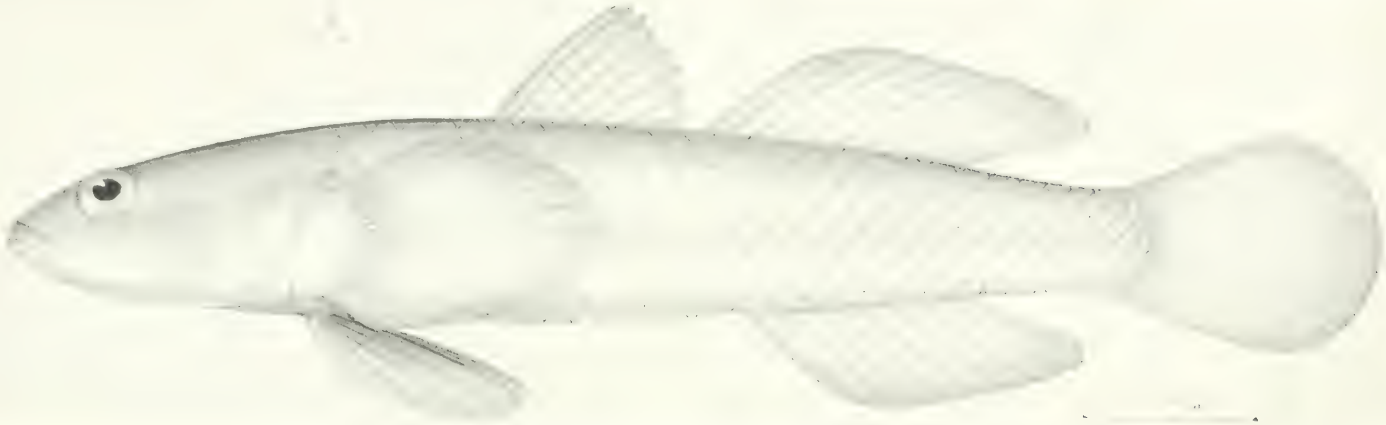
(a) Belloni peronidis Jordan



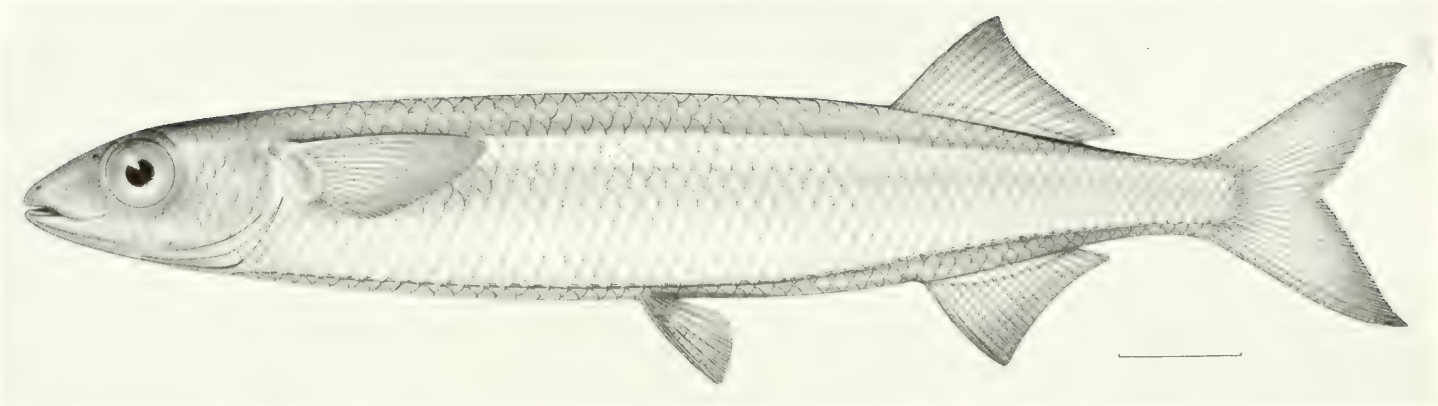
(b) Smithidis elegans Jordan and Gilbert.



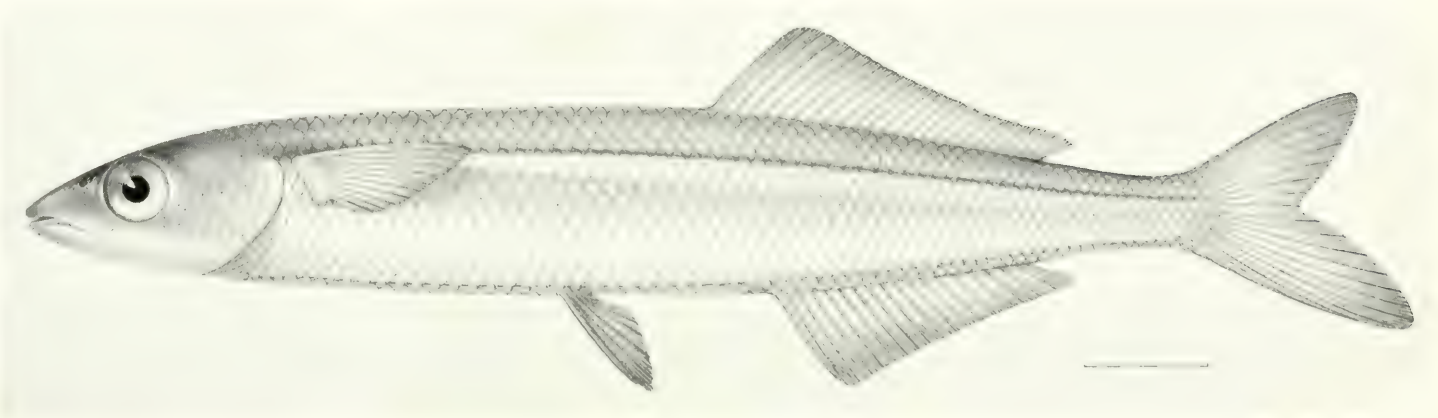
(a) ROGENIO VANCLEVEI Jordan



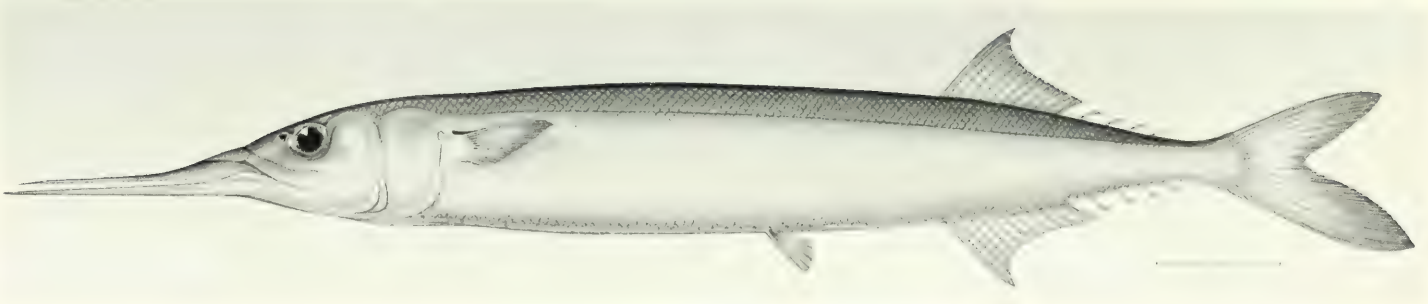
(b) ABOMA ANTIQUA Jordan and Gilbert.



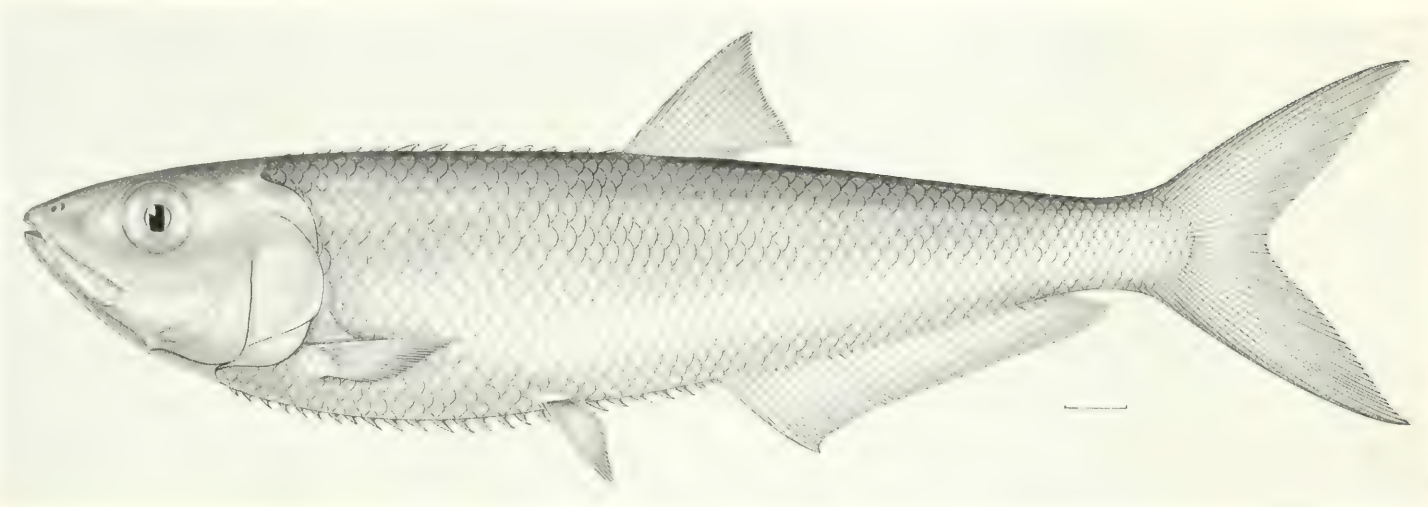
(*a*) ZELOTES ALHAMBRÆ Jordan.



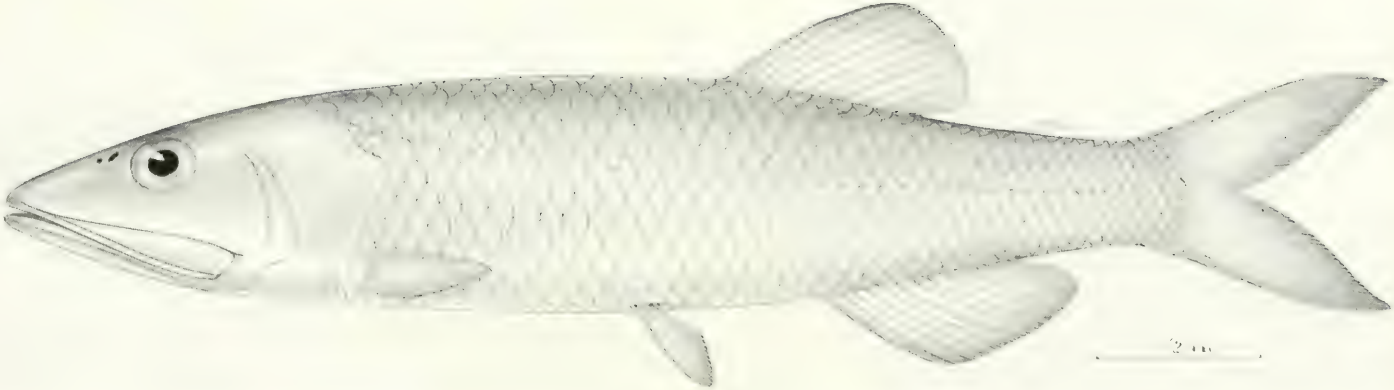
(*b*) ZELOSIS HADLEYI (Jordan and Gilbert).



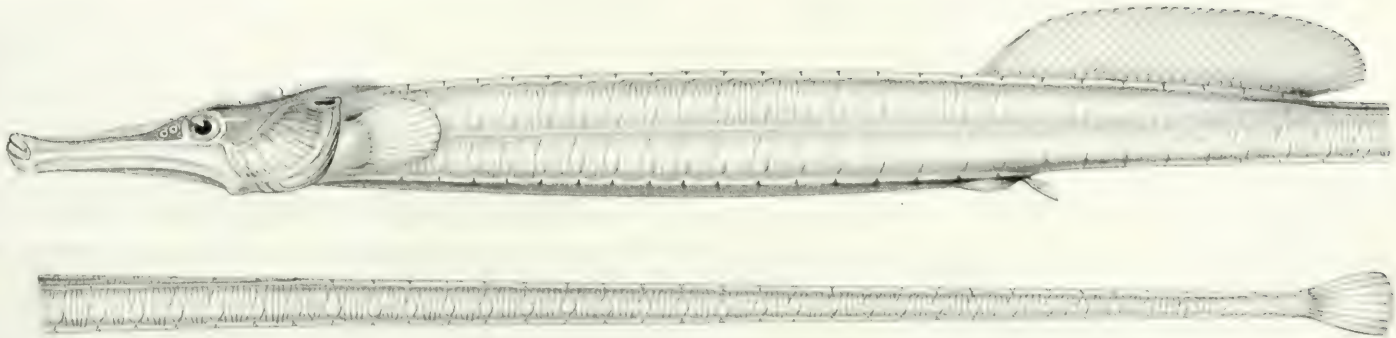
(*a*) Scomberessus acutillus (Jordan and Gilbert).



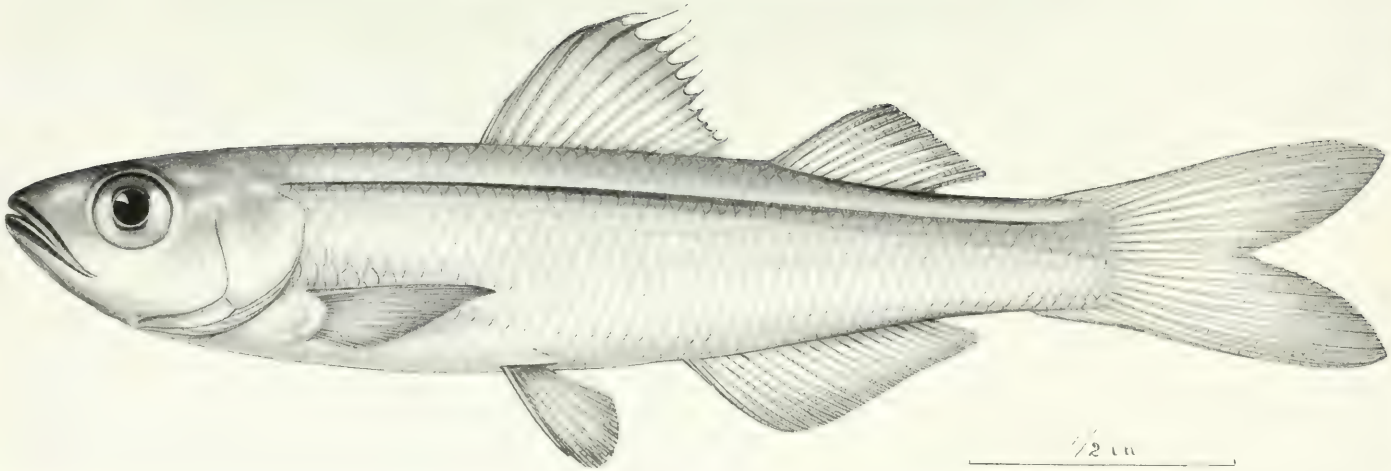
(*b*) Alisea grandis Jordan and Gilbert.



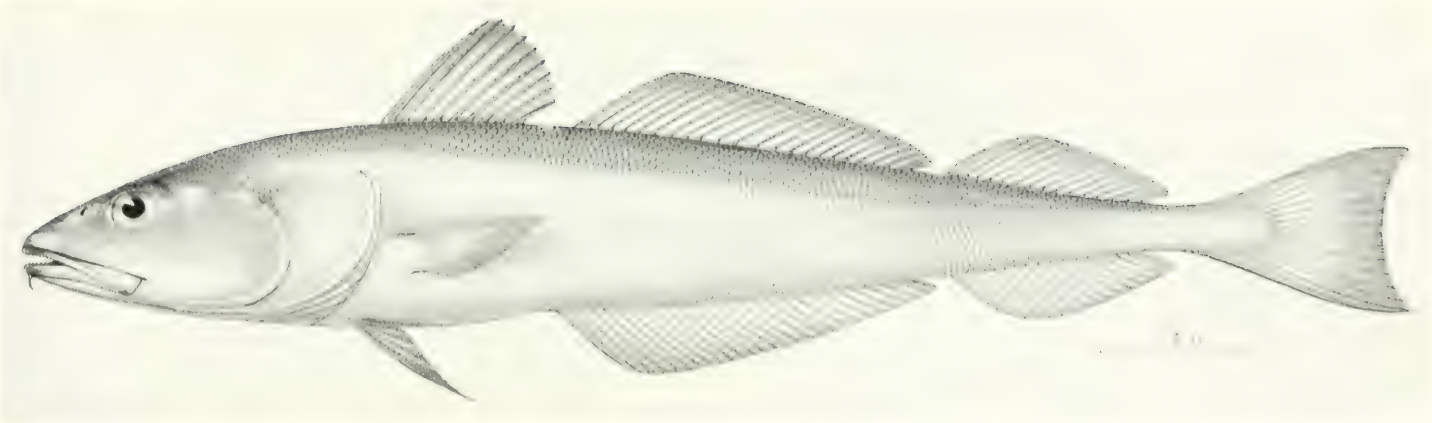

(*a*) TROSSULUS EXOLETUS Jordan



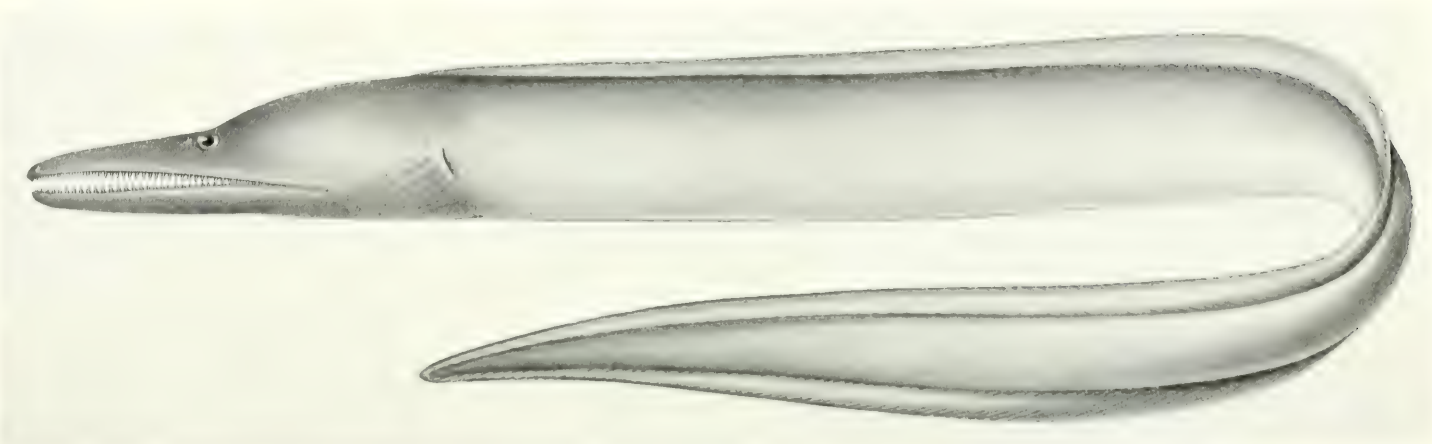
(*b*) SYNGNATHUS AVUS Jordan and Gilbert.



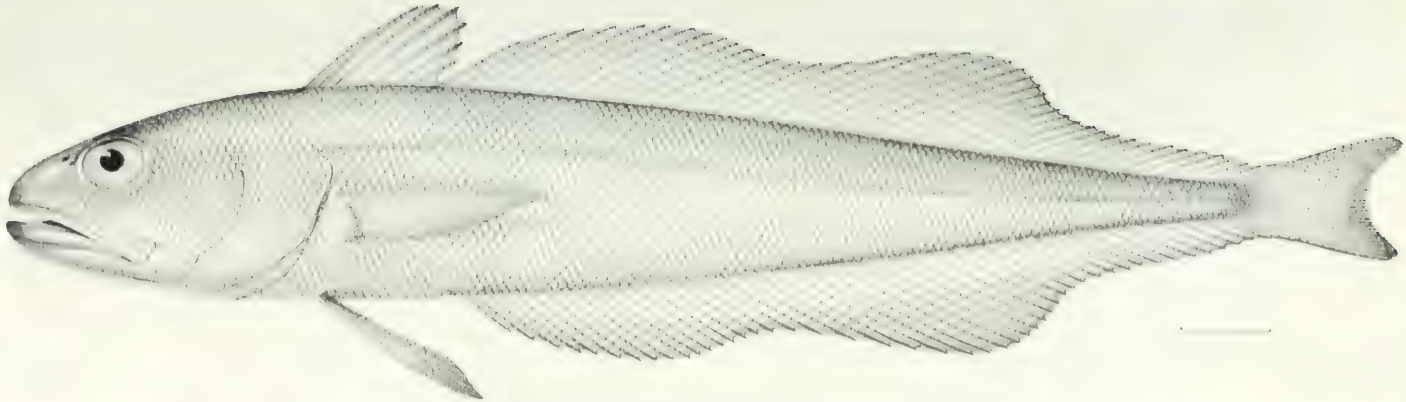

ZANTEOLITES HUBBSI Jordan and Gilbert.



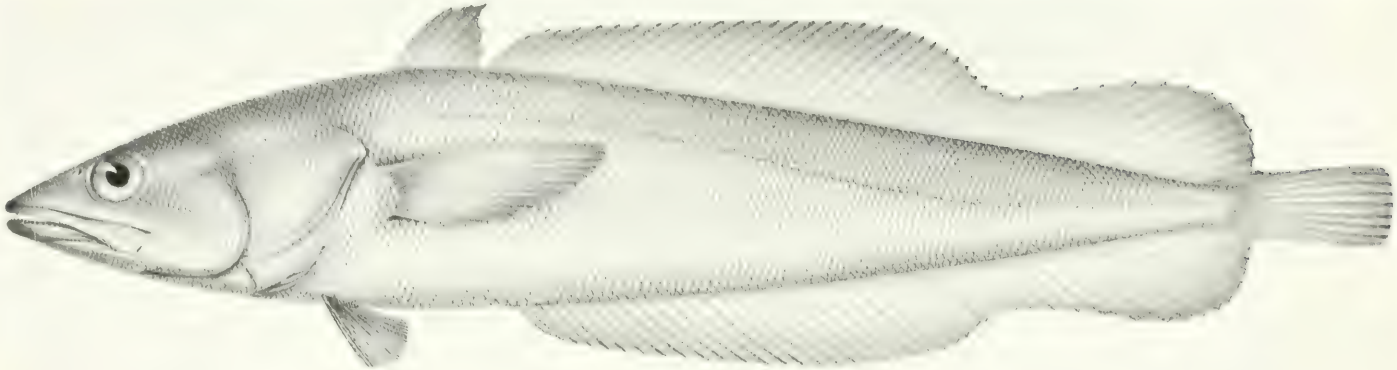
(*a*) Arnoldena infistia Jordan and Gilbert.



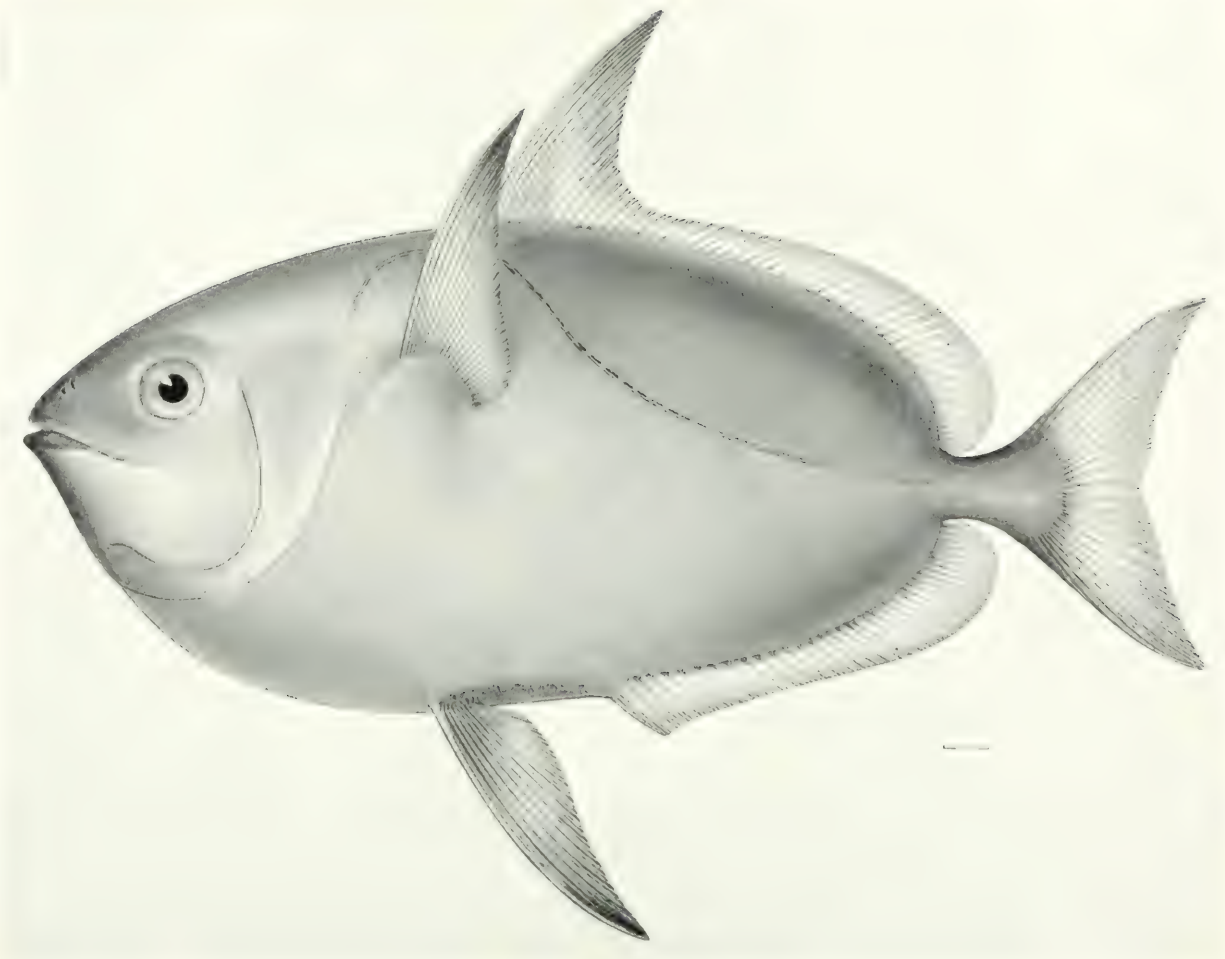
(*b*) Deprandus lestes Jordan and Gilbert.



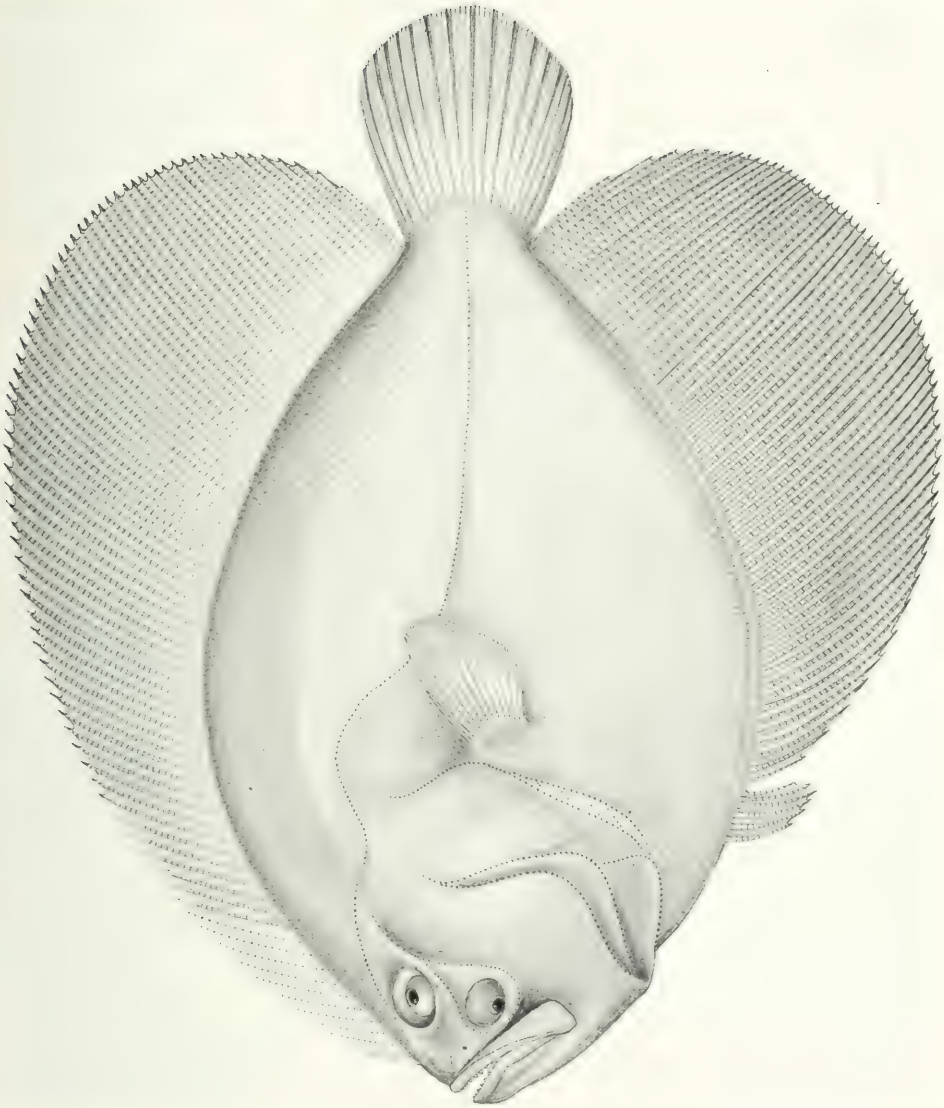
(*a*) ECLIPES MANNI Jordan.



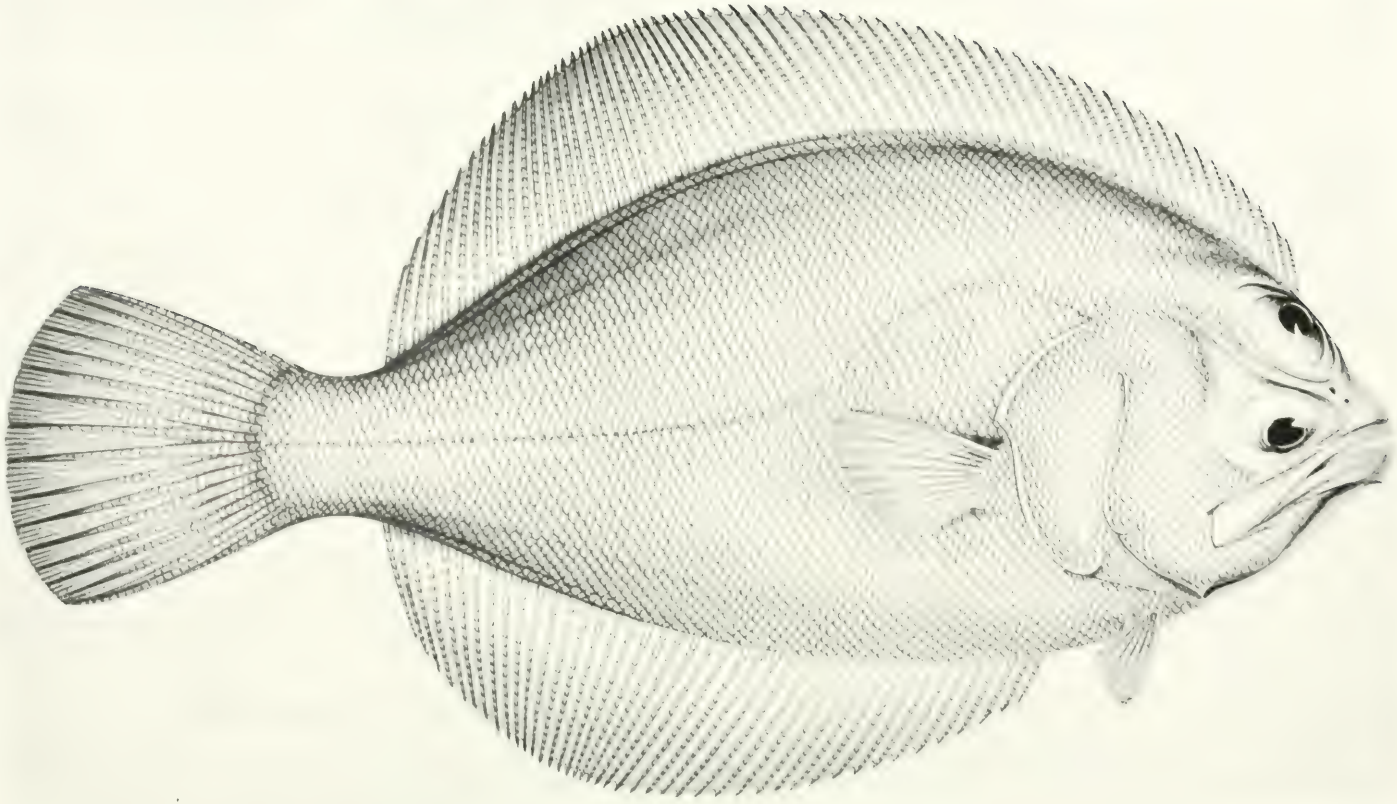
(*b*) ECLIPES VETERNUS Jordan and Gilbert.



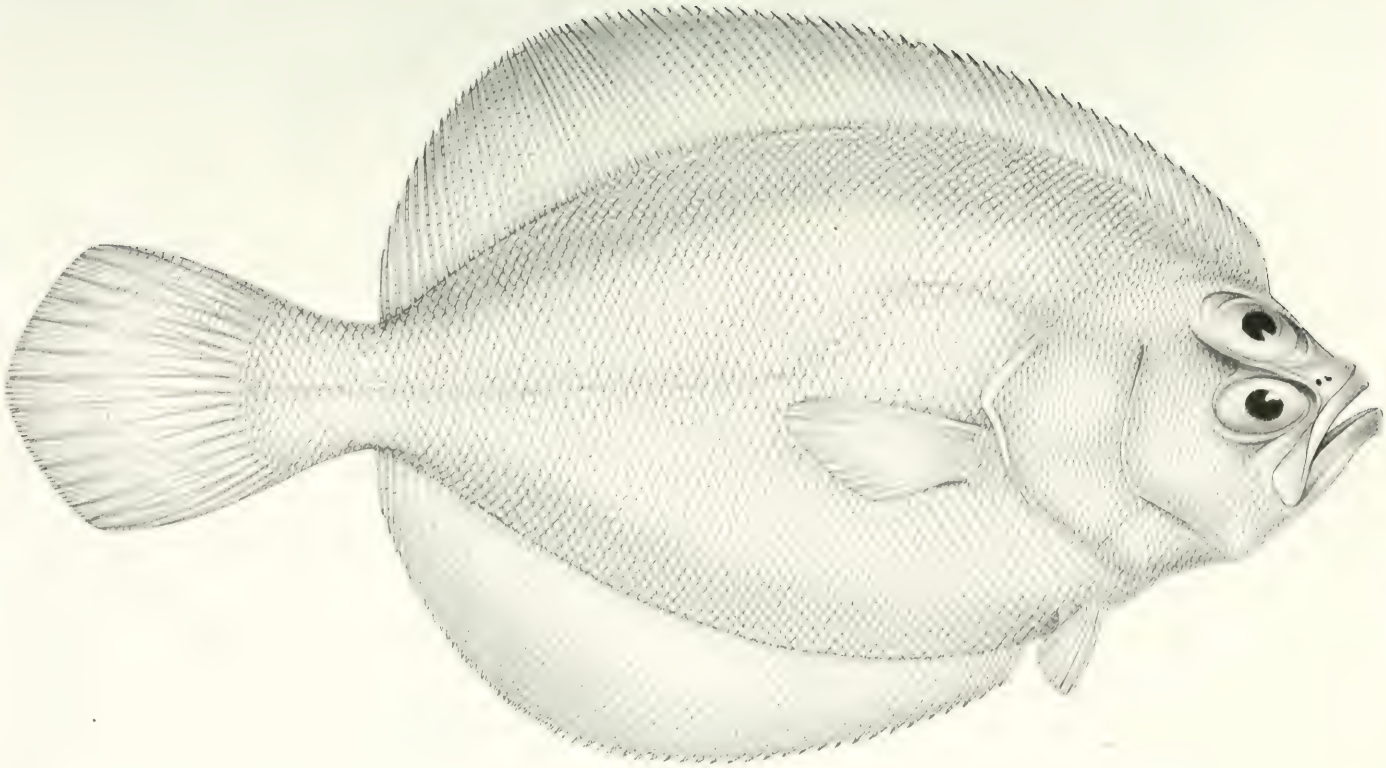
DIAPOMECA ZATIMA Jordan and Gilbert.



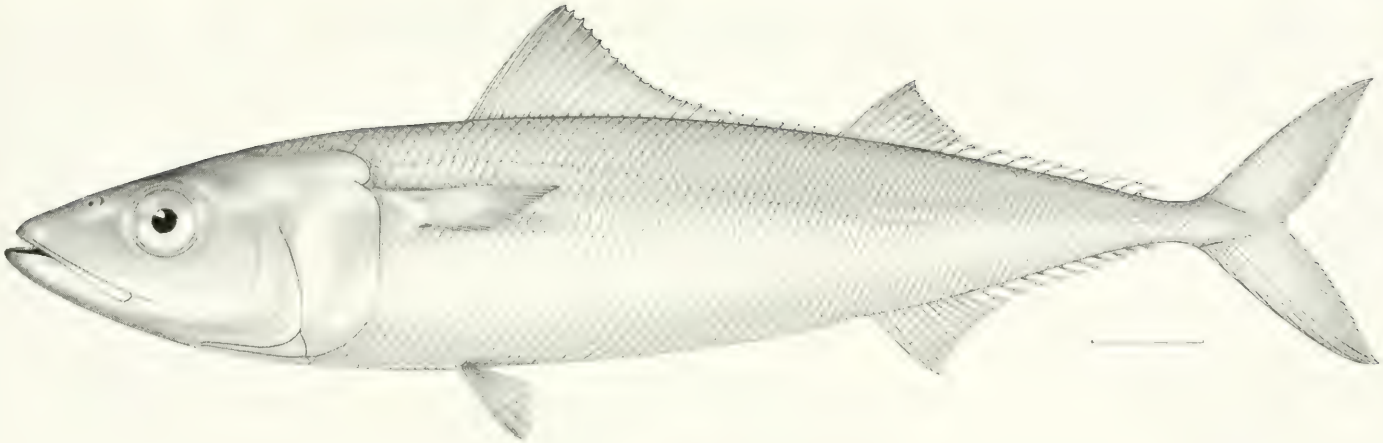
ZORORHOMBUS VELIGER Jordan.



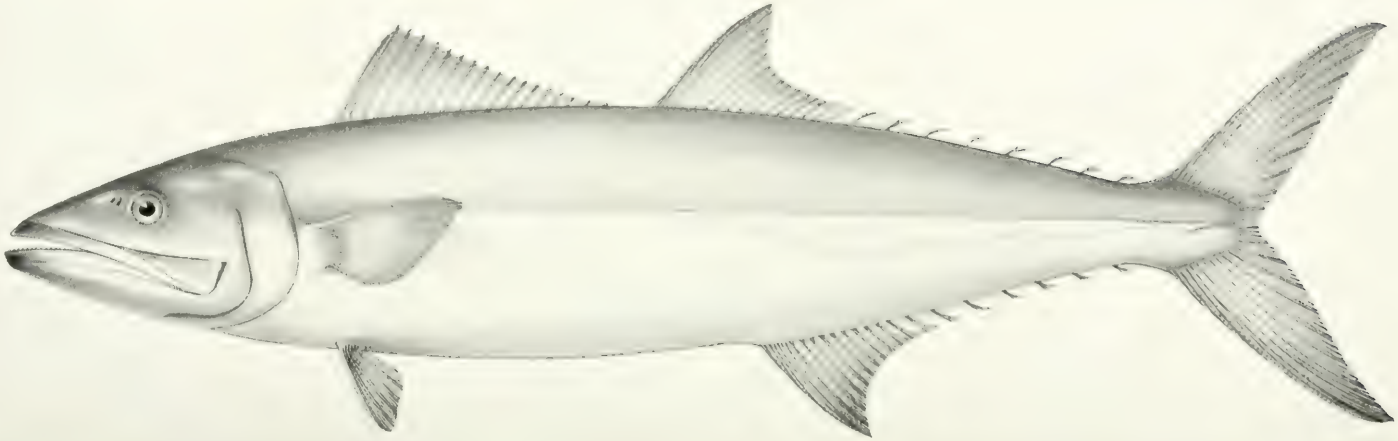
EVESTHES JORDANI Gilbert.



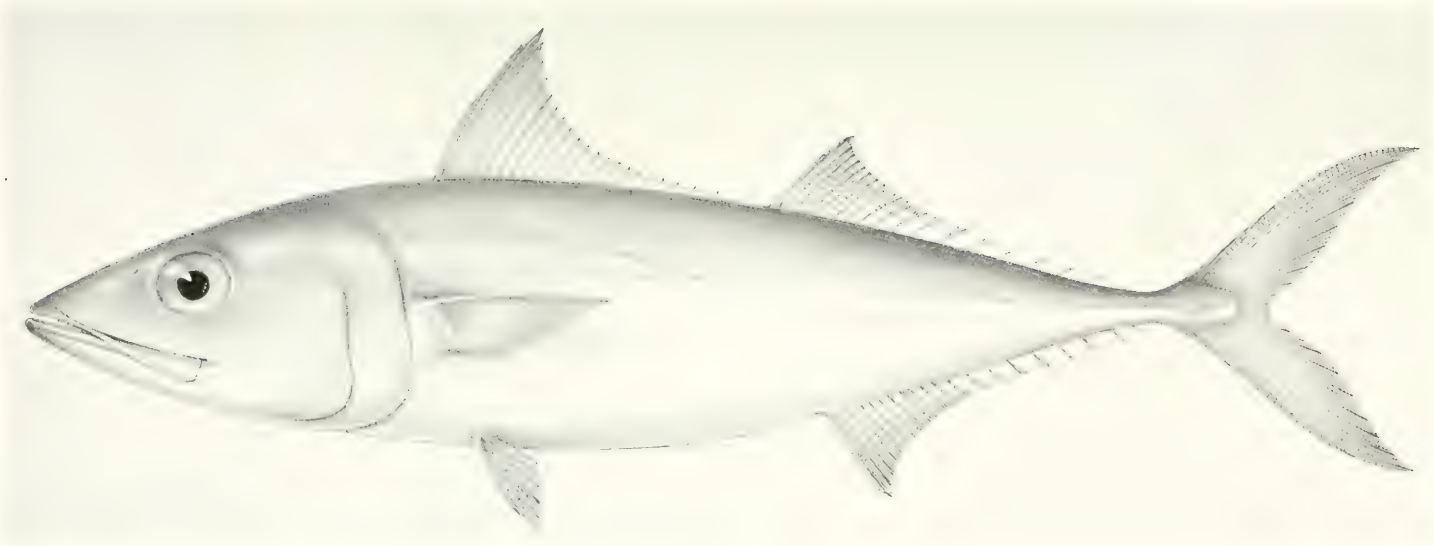
EVI THE HOOVERI Jordan



(a) Auxides rasson Jordan

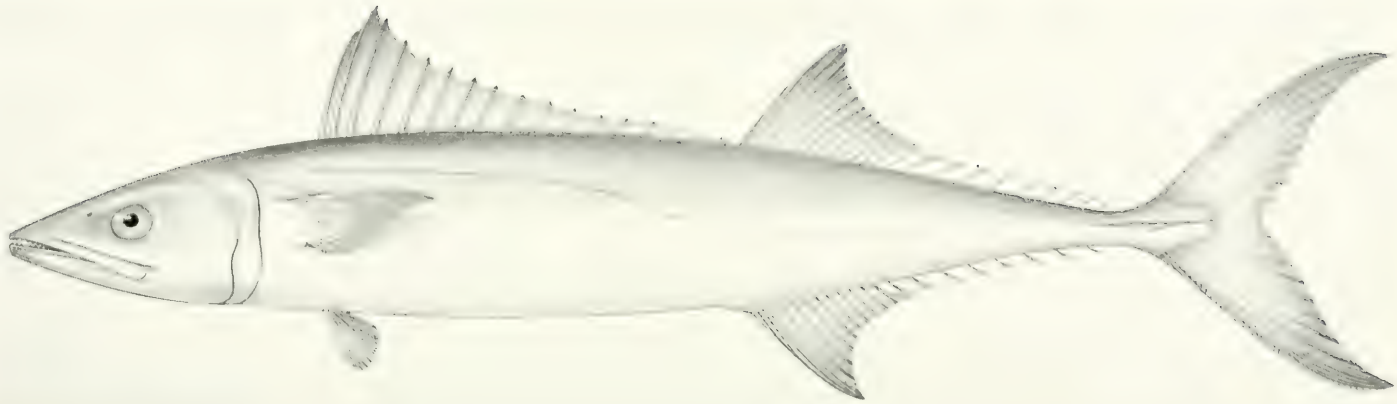


(b) Thyrsoides kriegeri (Jordan and Gilbert).



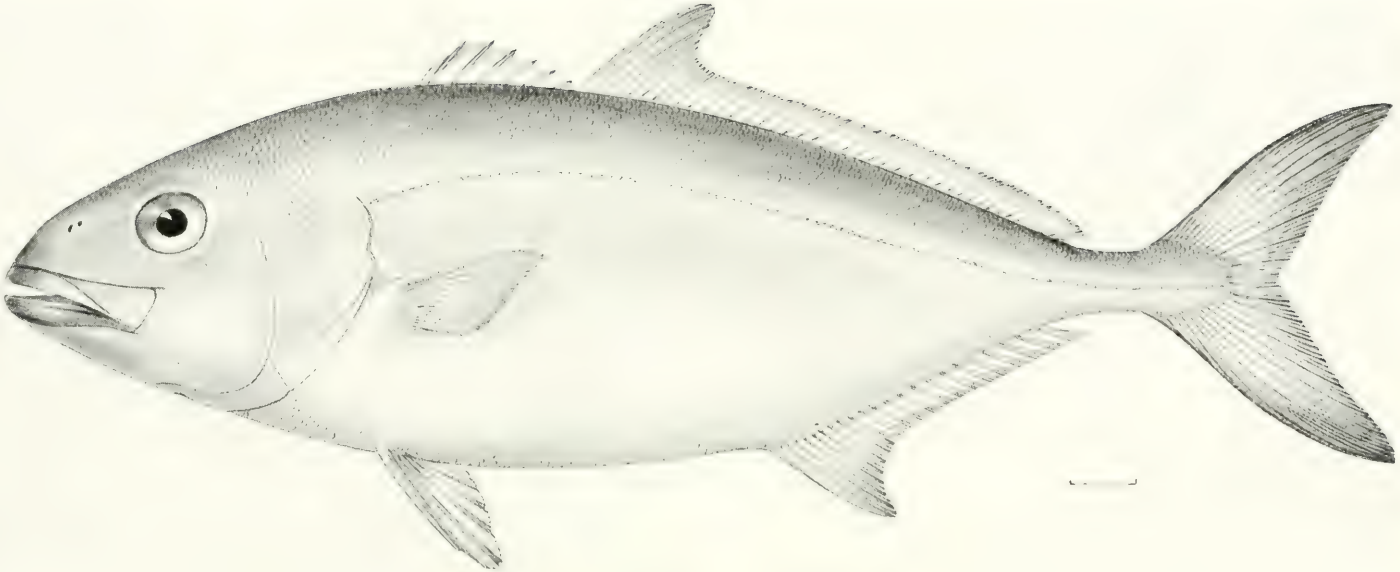
TURIO WILBURI Jordan and Gilbert

(a) ZAPHELGUS TENGURIO Jordan

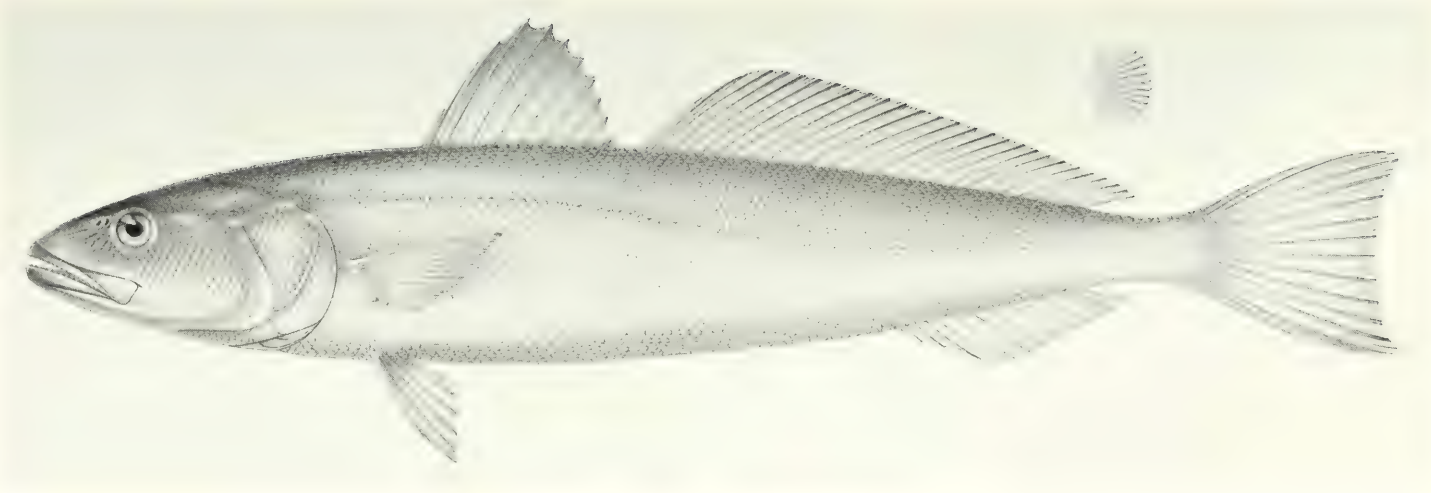


(b) OCYSTIAS SAGITTA Jordan

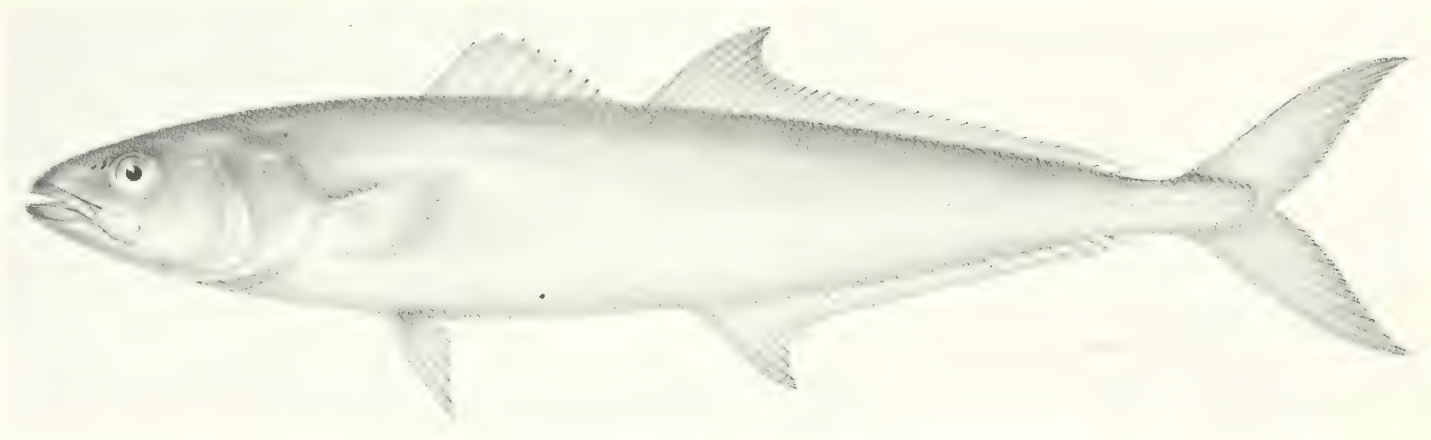
TUNITA OCTAVIA Jordan and Gilbert



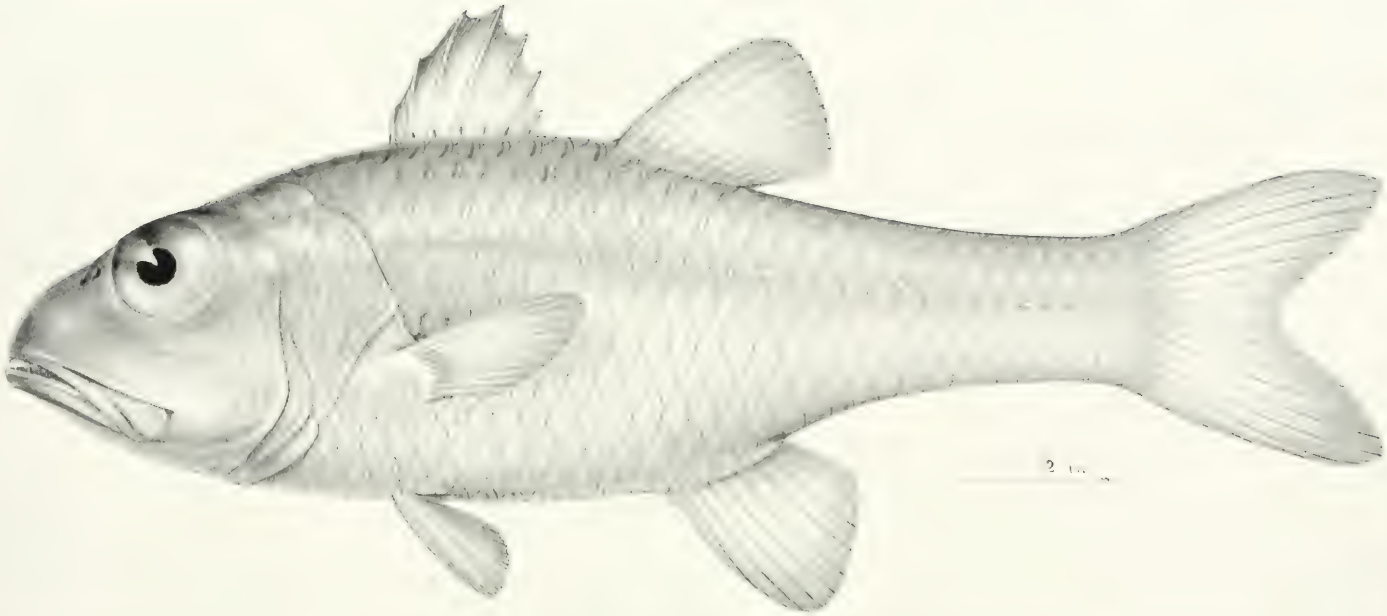
SERIOLA SANCTÆ BARBARÆ Jordan.



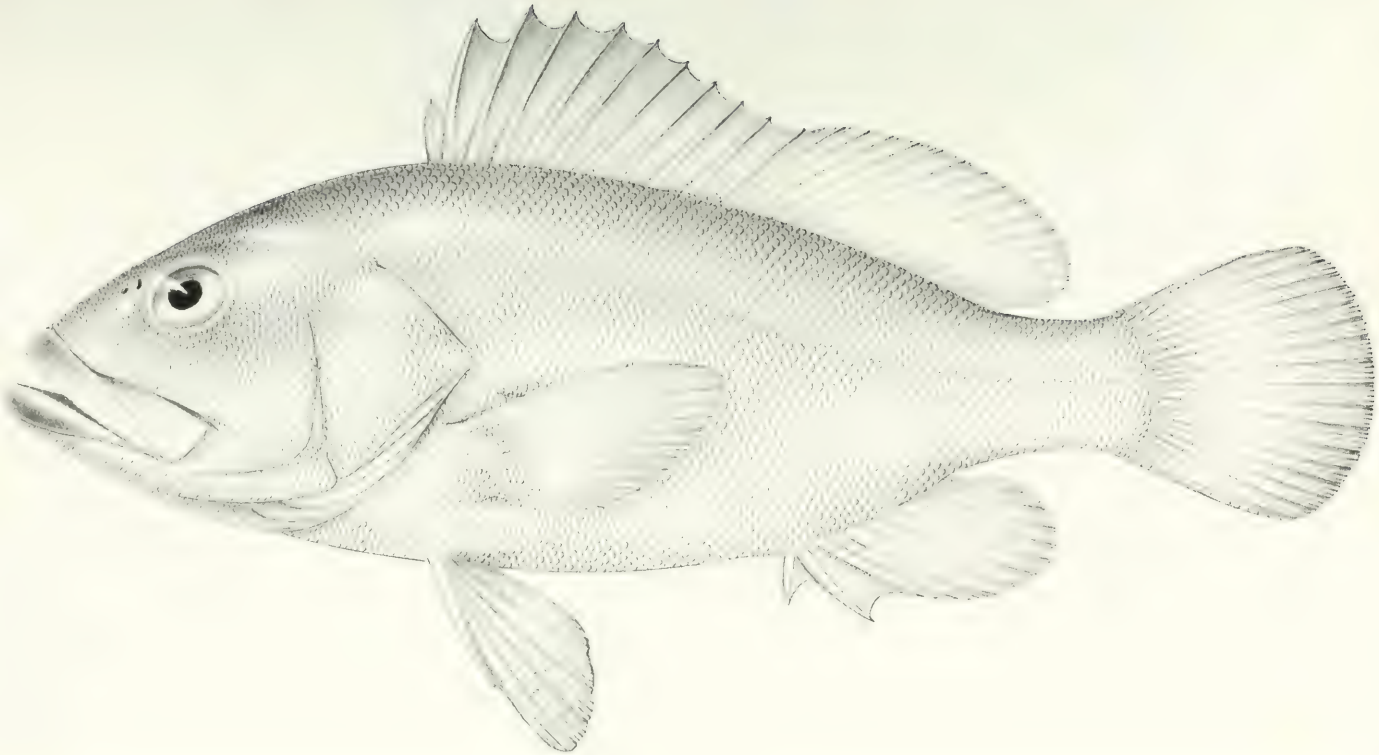
(*a*) ATKINSONELLA STRIGILIS Jordan.



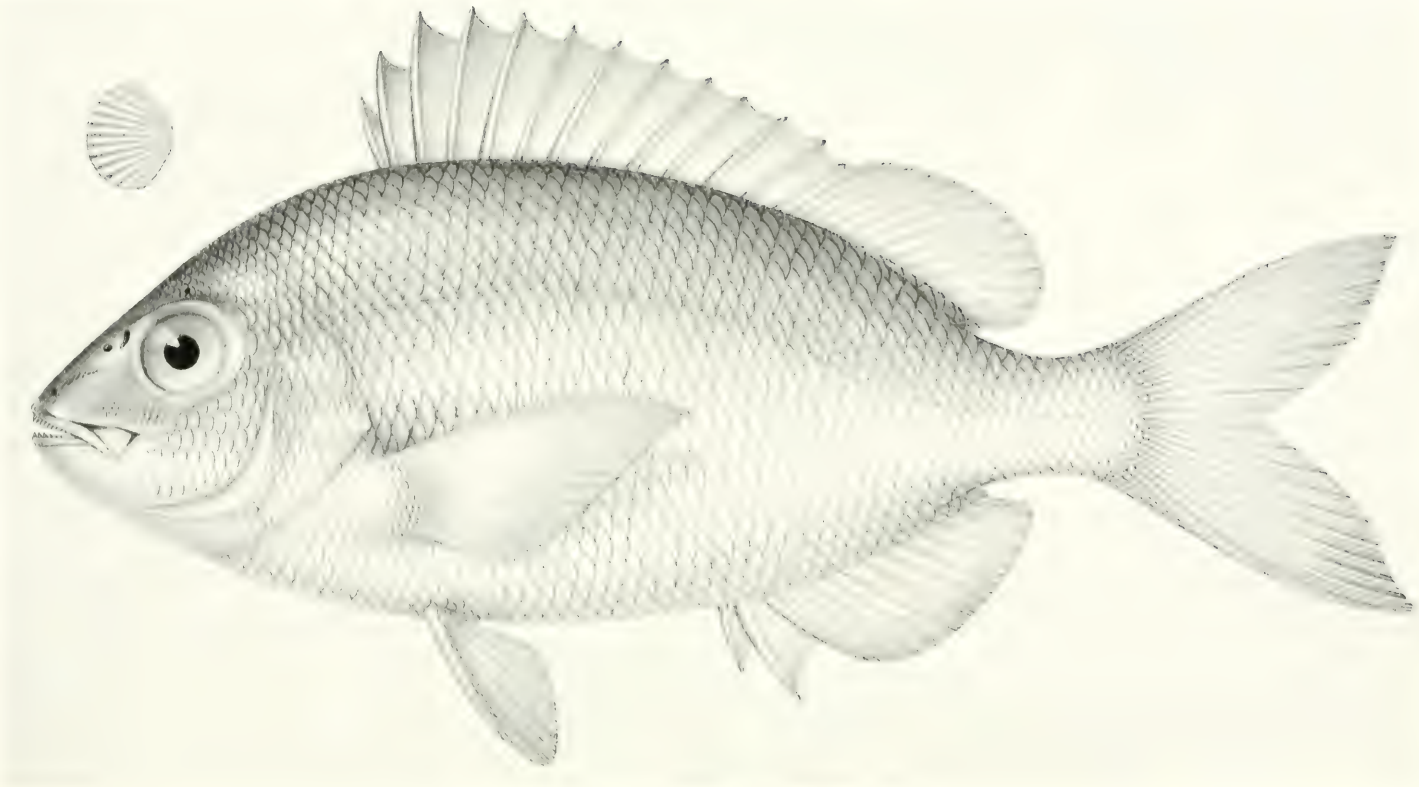
(*b*) LOMPOCHITES HOPKINSI Jordan.



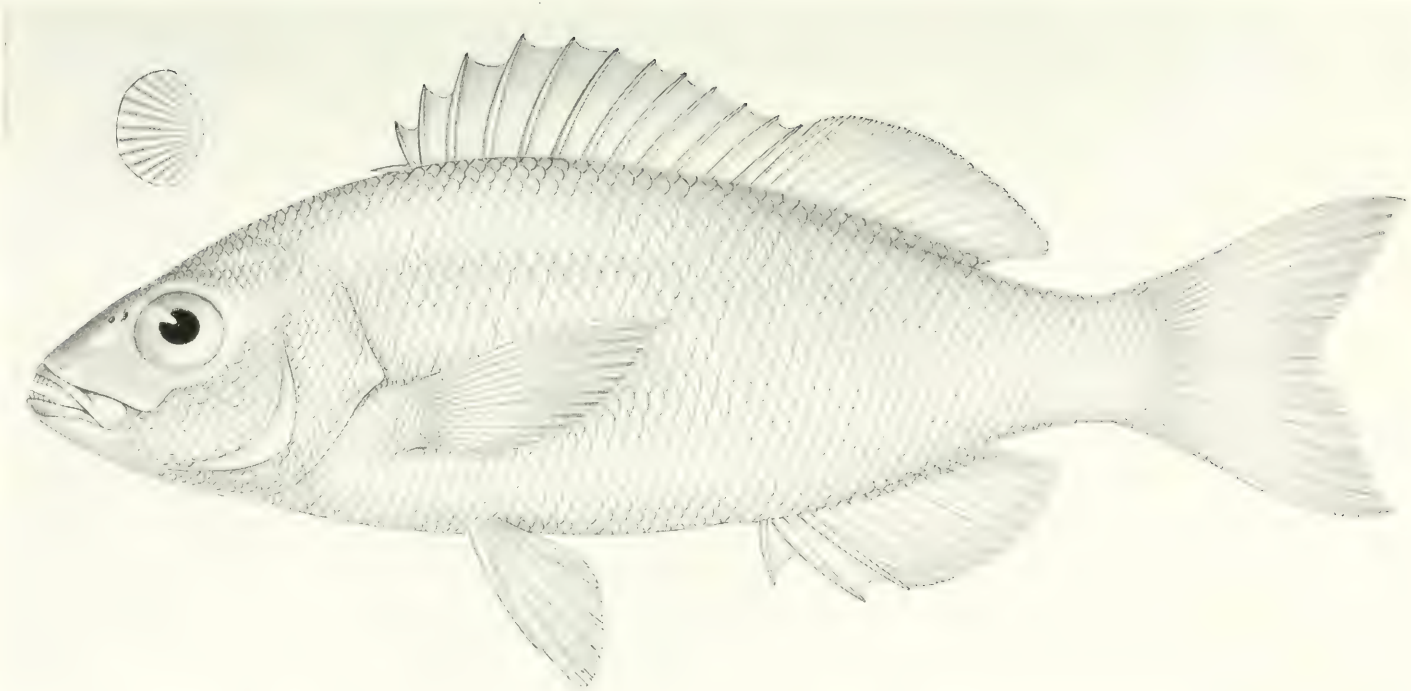

ERITHALA FAVIDUS Jordan and Gilbert.



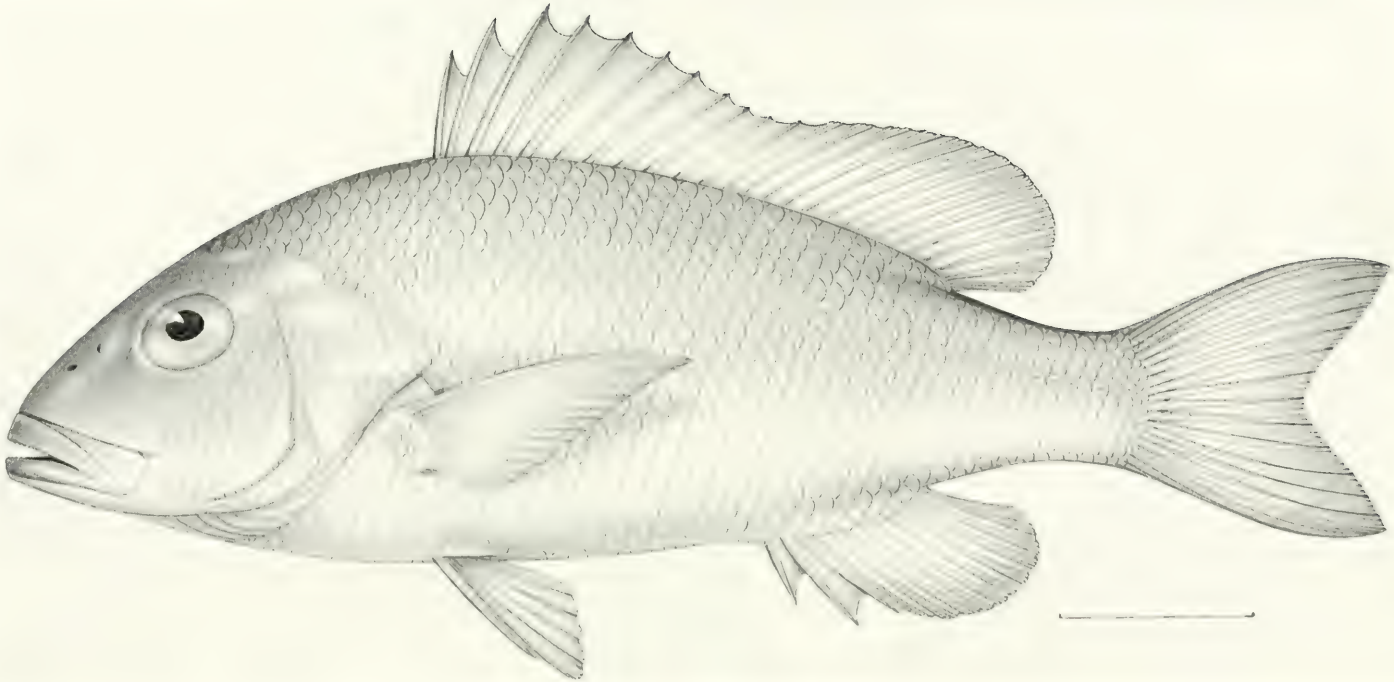
EMMELCHÆRE RHOMALEA Jordan.



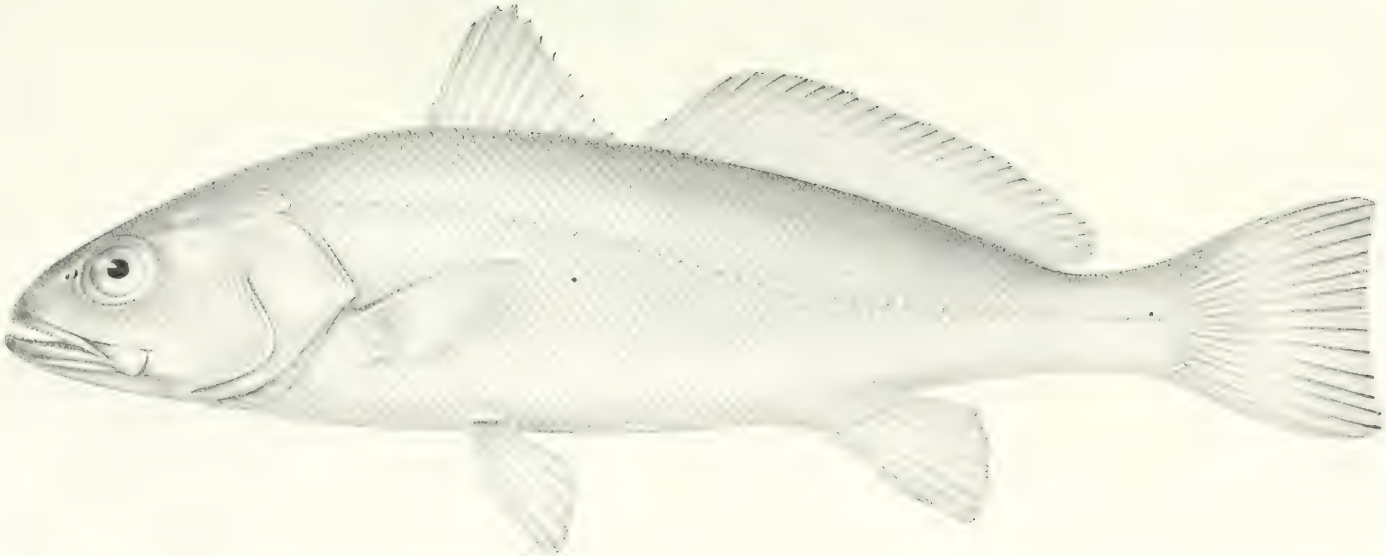
RHYTHMIAS STARRII Jordan and Gilbert.



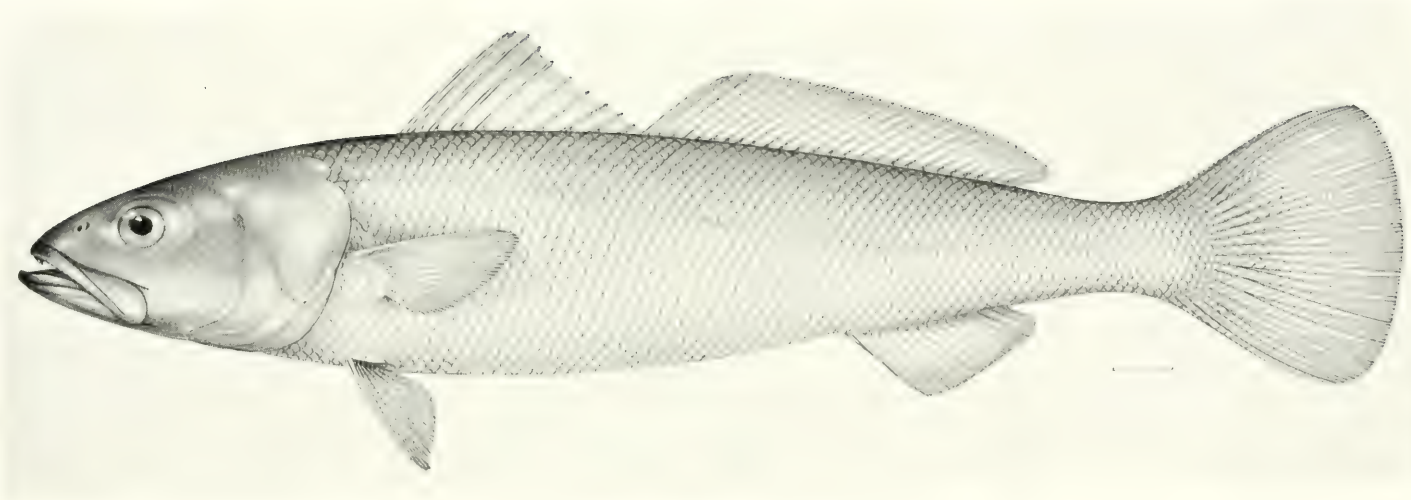
PLECTRITES CLASSENI Jordan.



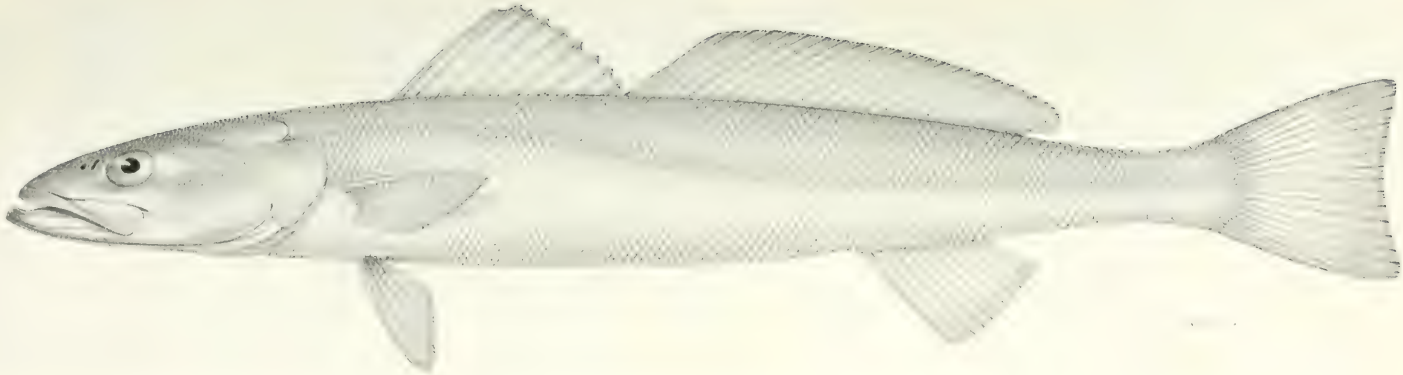
NEOMENIS HAGARI (Jordan and Gilbert)



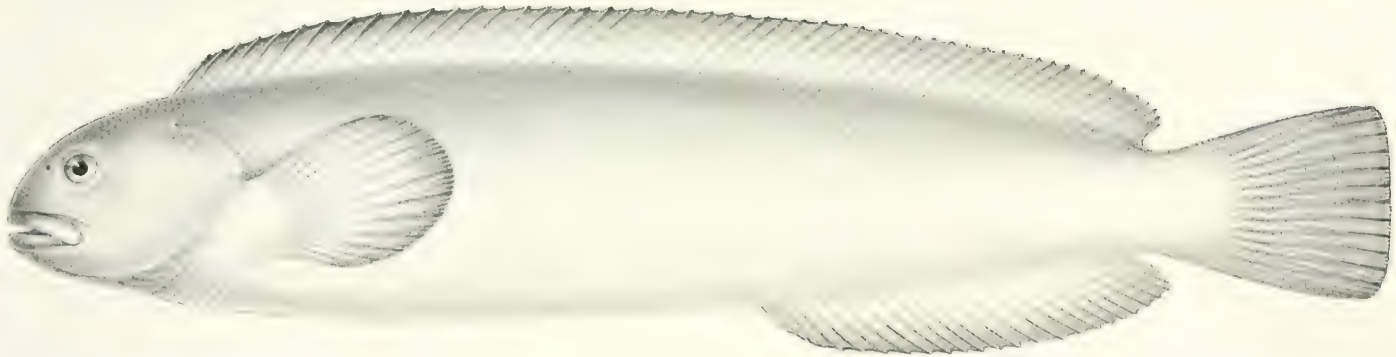
LOMPOQUIA RETROPES Jordan and Gilbert.



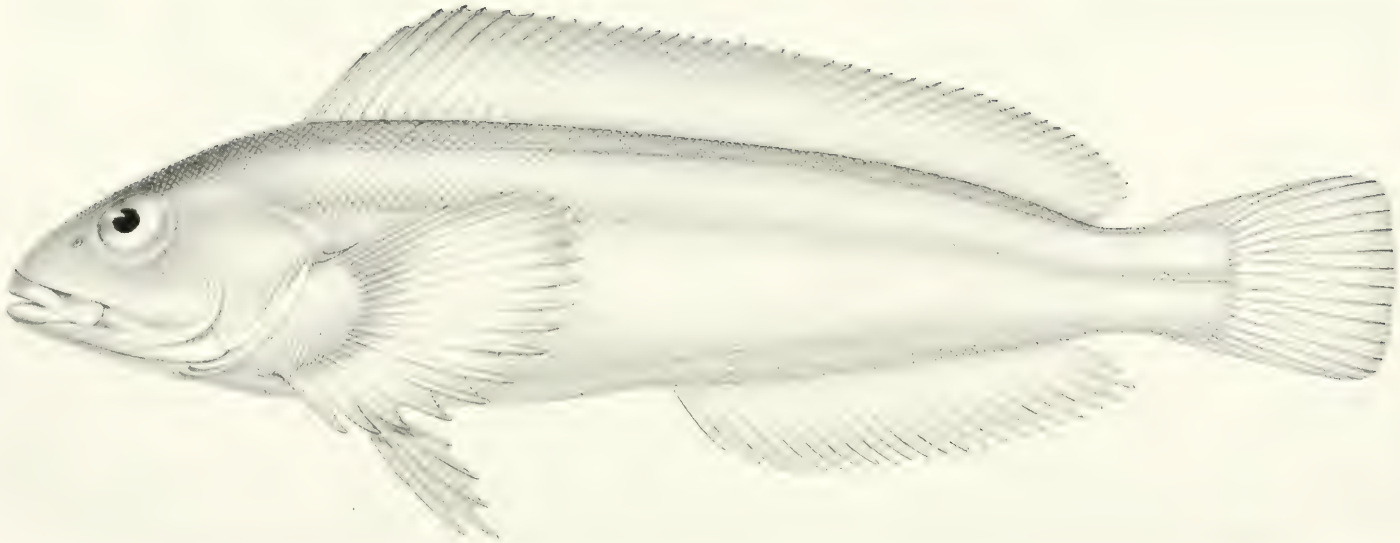
ARISTOSCION EPREPES Jordan.



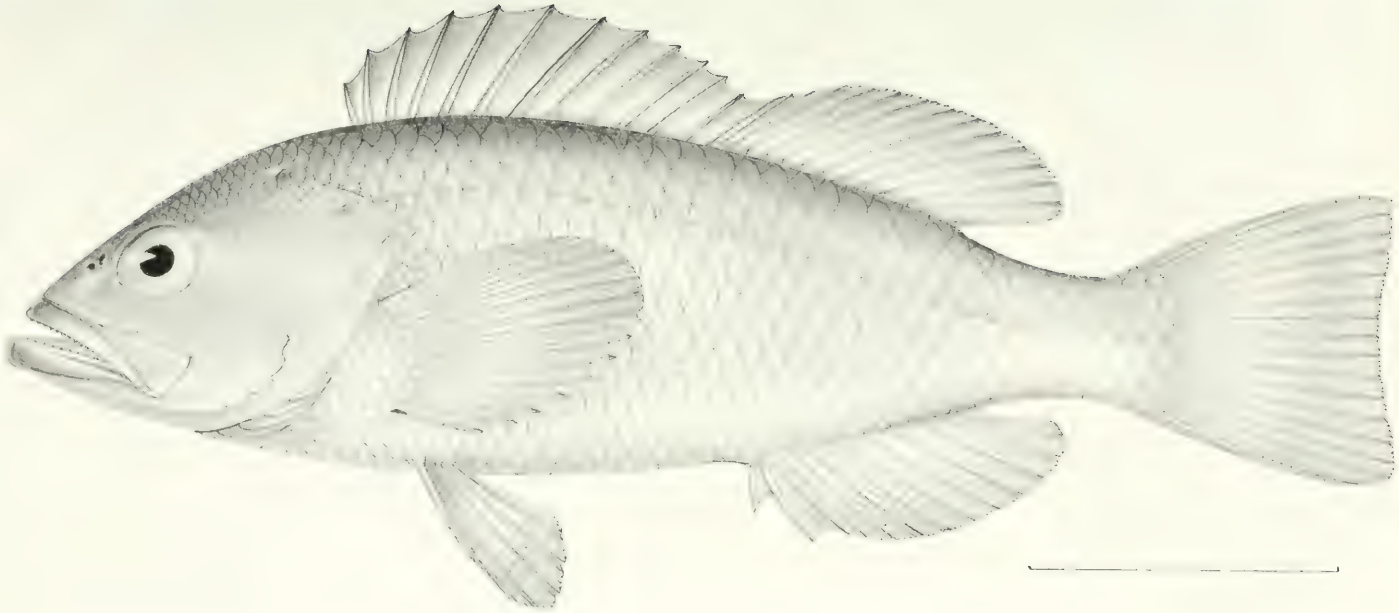
(*a*) IOSCION MORGANI Jordan.



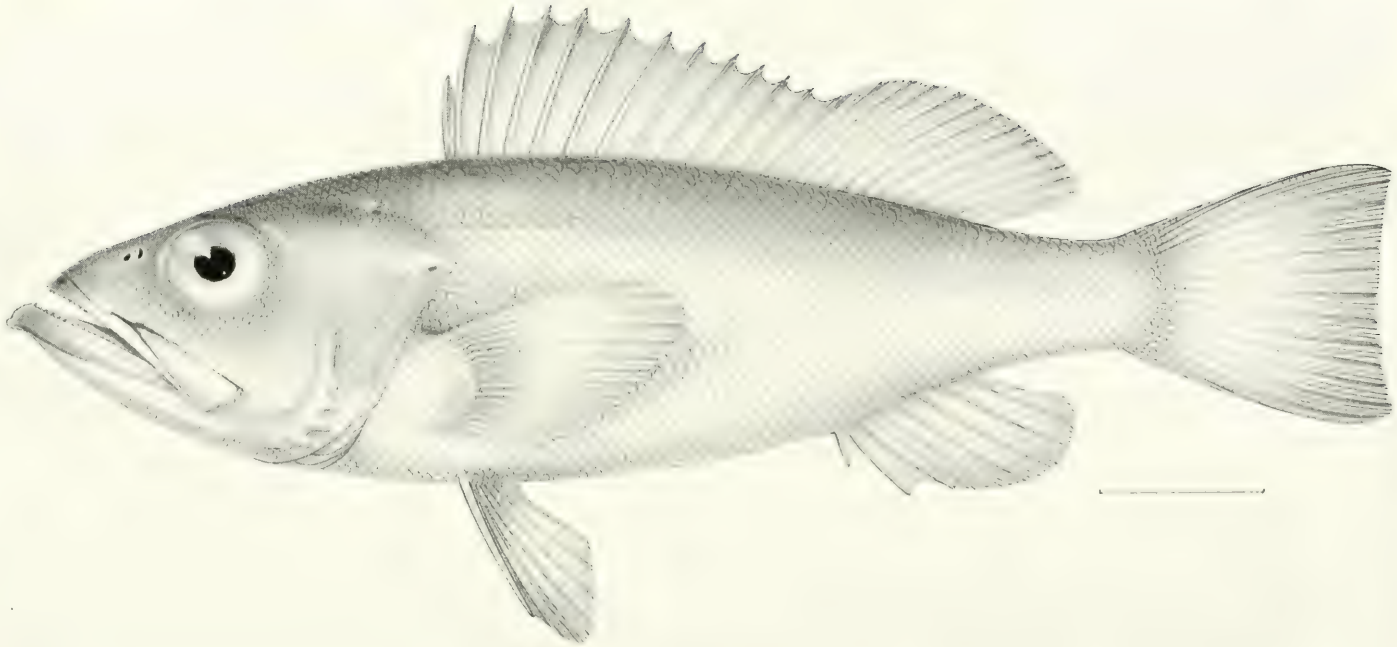
(*b*) ARÆOSTEUS ROTHI Jordan and Gilbert.



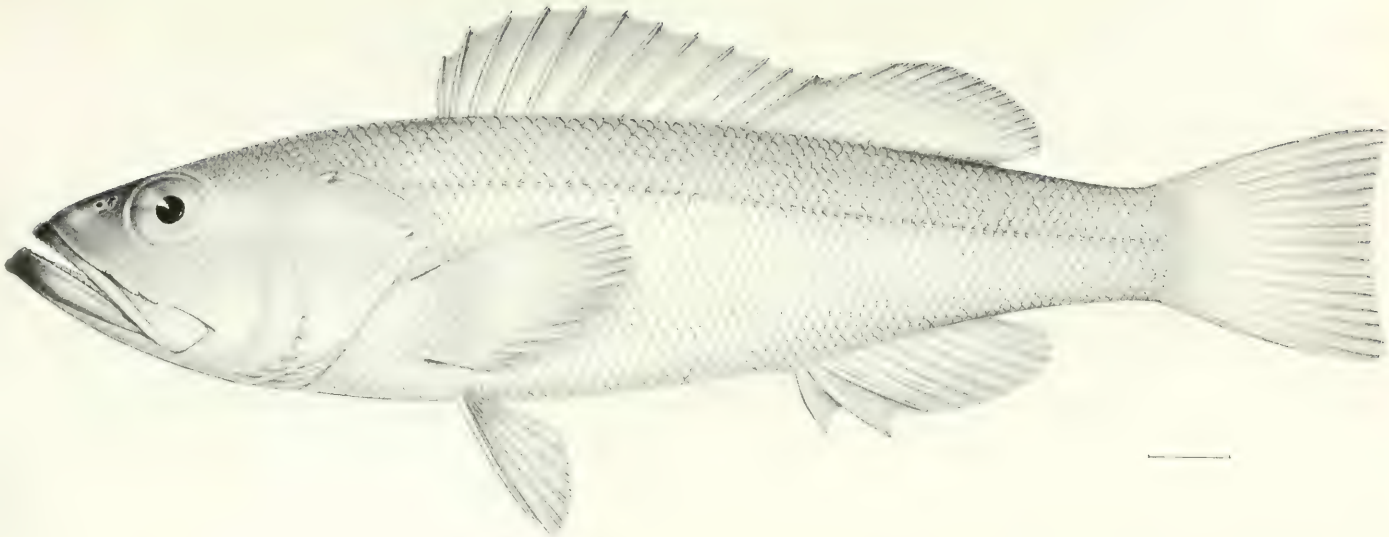
ZEMMIAGRAMMUS ISISTIUS Jordan.



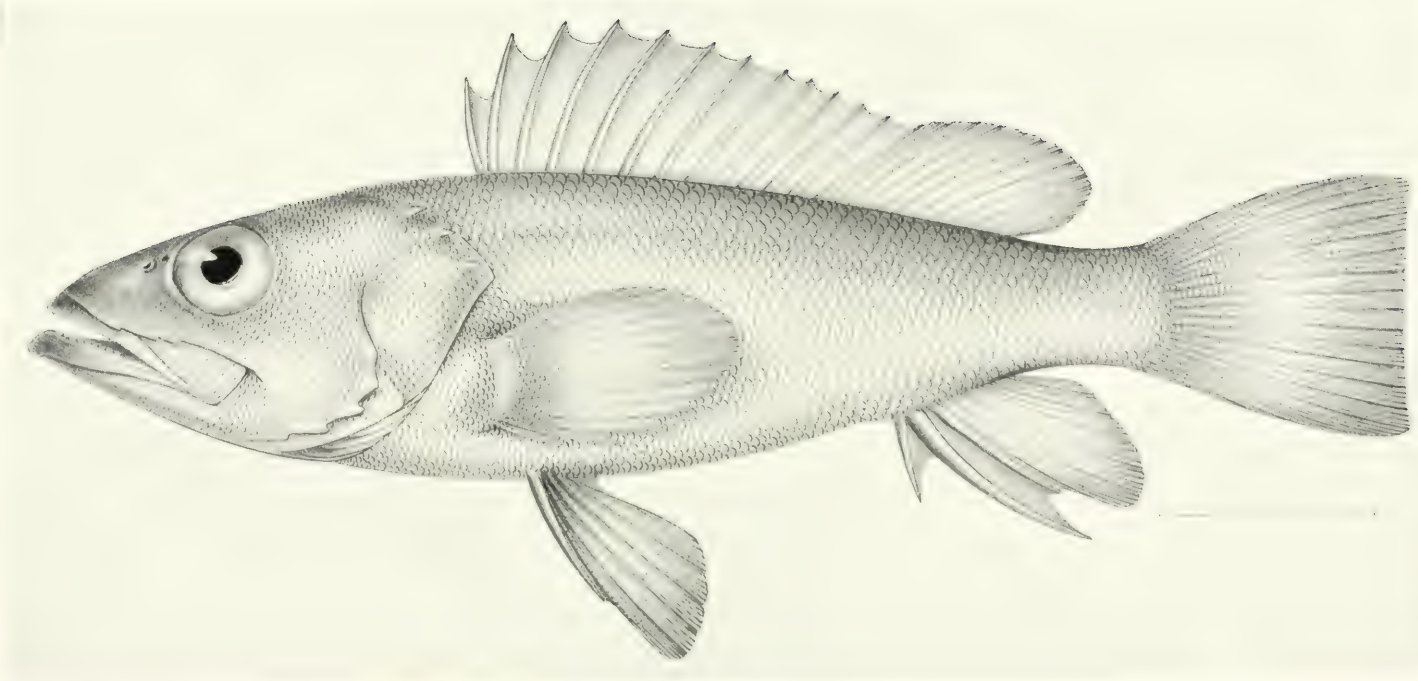
SEBASTAVUS VERTEBRALIS Jordan and Gilbert.



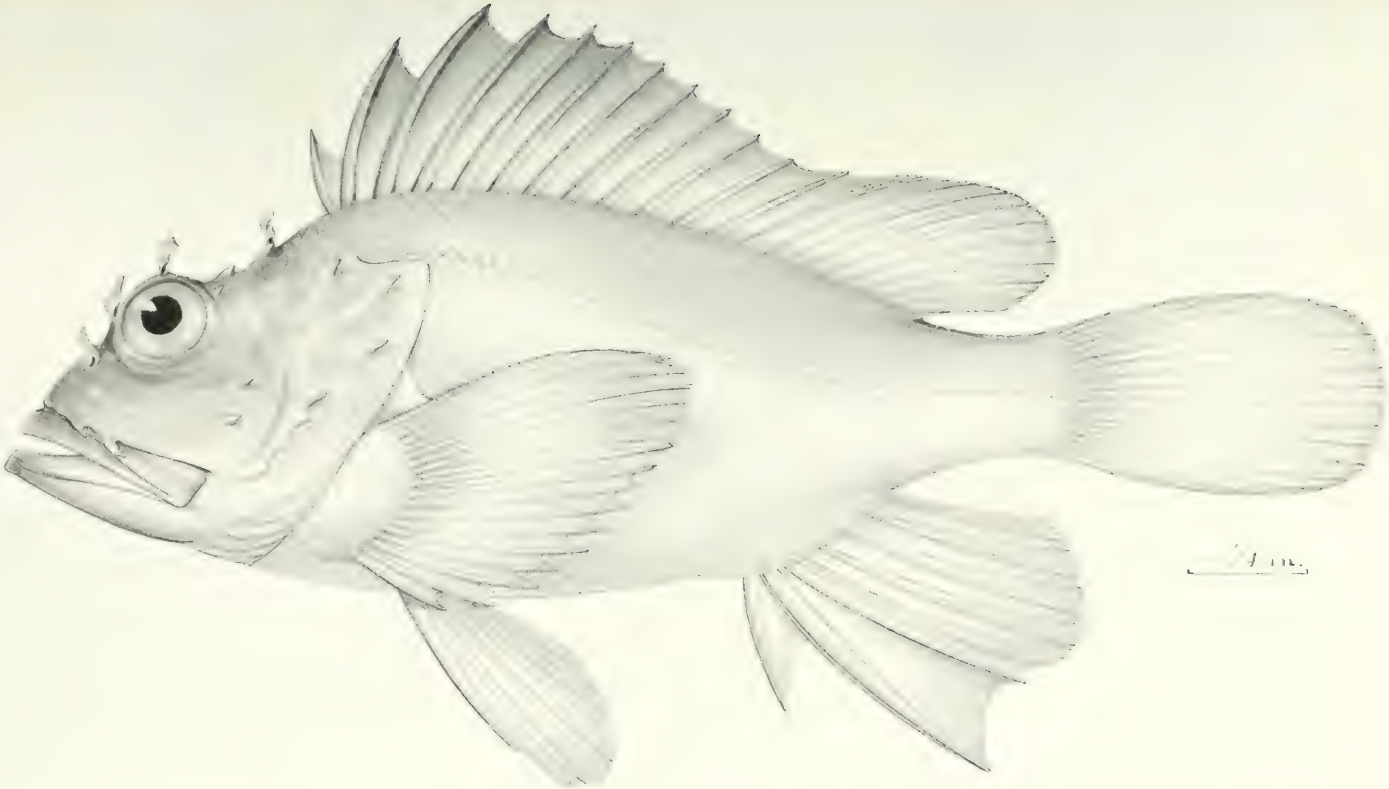
RIXATOR PORTFOUSI Jordan and Gilbert.



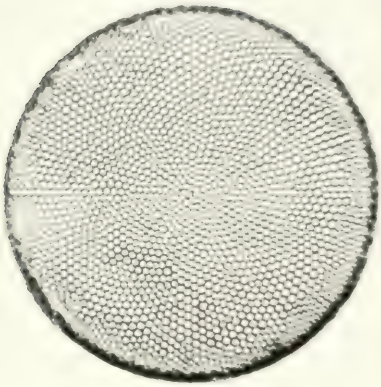
SEBASTOESSUS APOSTATES Jordan.



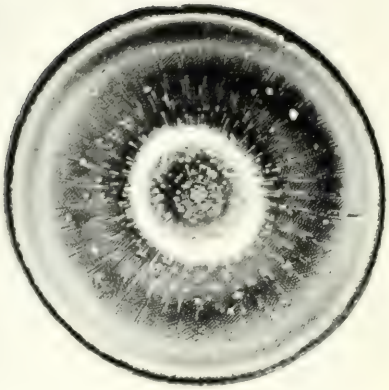
SEBASTINUS INEZIÆ (Jordan).



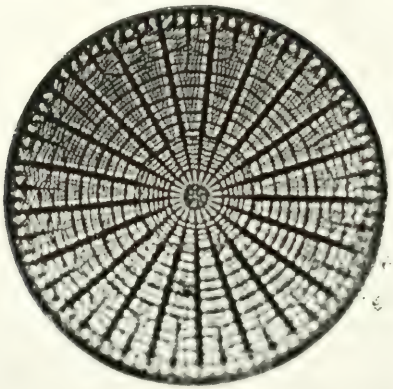
RHOMARCHUS ENSIGER Jordan and Gilbert.



(*a*) Coscinodiscus borealis.

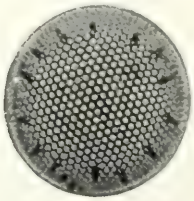


(*b*) Actinocyclus Ehrenbergii.

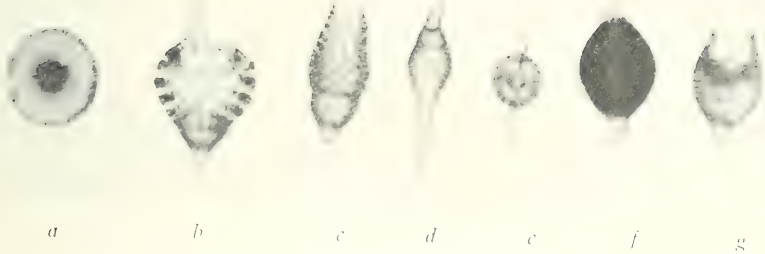


(*c*) Arachnoidiscus ornatus.

(*d*) Actinoptychus undulatus.



(*e*) Stephanopyxis corona.




(*a*) PERIPHANTA DECORA.
(*b*) PODOCYRTIS CENTRISCUS.
(*c*) EUCYRTIDIUM ELEGANS.
(*d*) EUCYRTIDIUM SIPHO.
(*e*) STYLOSPHŒRA CORONATA.
(*f*) SPERIGOSPHŒRA PACHYSTYLA.
(*g*) PODOCYRTIS MITRELLA.

[End of Vol. I.]

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