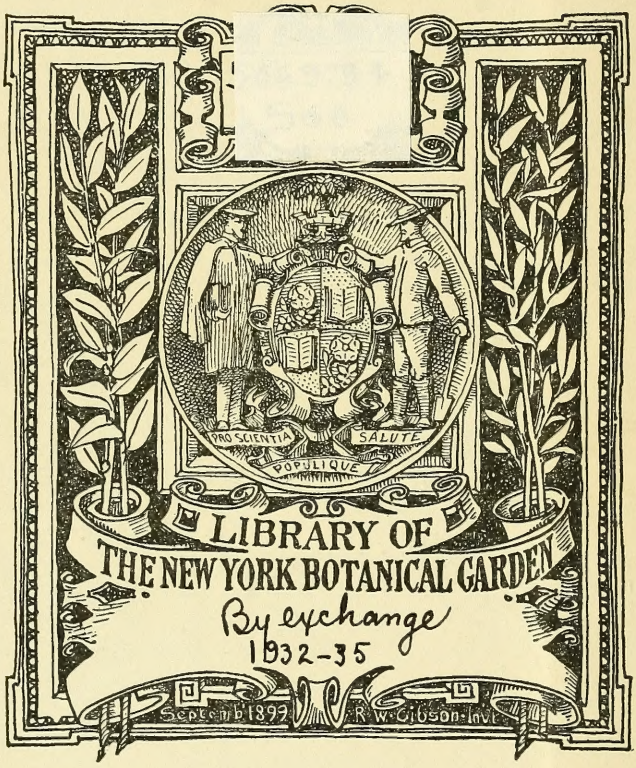
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CONTENTS

Issued May 30, 1932

Southern California Academy of Sciences

OFFICE OF THE ACADEMY

Los Angeles Museum, Exposition Park,
Los Angeles, Cal.

AN UNDESCRIBED TEPONAZTLI OR AZTEC DRUM

By Arthur Woodward

It is a well known fact that the ancient Mexicans were probably the finest wood carvers on the North American continent in prehistoric times. Existing specimens of their art, as well as the Spanish accounts written during the early contact period, attest this skill.

Modern authors and scientists delving into the subject have described various objects preserved through the centuries, and which at the present time are distributed among museums throughout the world.

The best work yet written upon the craftsmanship of the ancient Mexicans is "The Wood-Carver's Art in Ancient Mexico," by Prof. Marshall H. Saville, published by the Museum of the American Indian, Heye Foundation, New York, 1925.

In this interesting and exceedingly valuable work, Prof. Saville illustrates the majority of the best items of the Mexican wood carver's art now in existence. Among the most important specimens described are, the spear-thrower (*atlatl*) and the horizontal drum (*teponaztli*).

According to Saville[1] "Wooden drums played an important part in the civic and religious life of the ancient Mexicans as we learn from the numerous references to them in early chronicles and from representations in picture writings which have come down to us.

Drums were of two major types, namely, the horizontal drum called *teponaztli,* a hollowed-out log, the ends left solid, the bottom open, and the upper part cut through in a manner resembling the letter H, leaving two slender vibrating tongues, the ends opposite each other; and the upright drum, the *huehuetl,* also a hollowed log with open ends, over the upper one being stretched the skin of an animal. These Mexican or Nahuan names still survive in Mexico, both types of drums being now played on festival occasions by natives in various parts of the country."

Upon these *teponaztlis* the ancient craftsmen lavished their skill, carving intricate patterns in the hard wood. Often these drums were gilded or painted.

These drums booming from the *teocallis* or temples must have been awe-inspiring to the Spanish soldiery. Various chroniclers note the feeling of depression brought about by the sound of the *teponaztlis* and the *huehuetls.*

[1] Saville, Marshall H., The Wood Carver's Art in Ancient Mexico, p. 54.

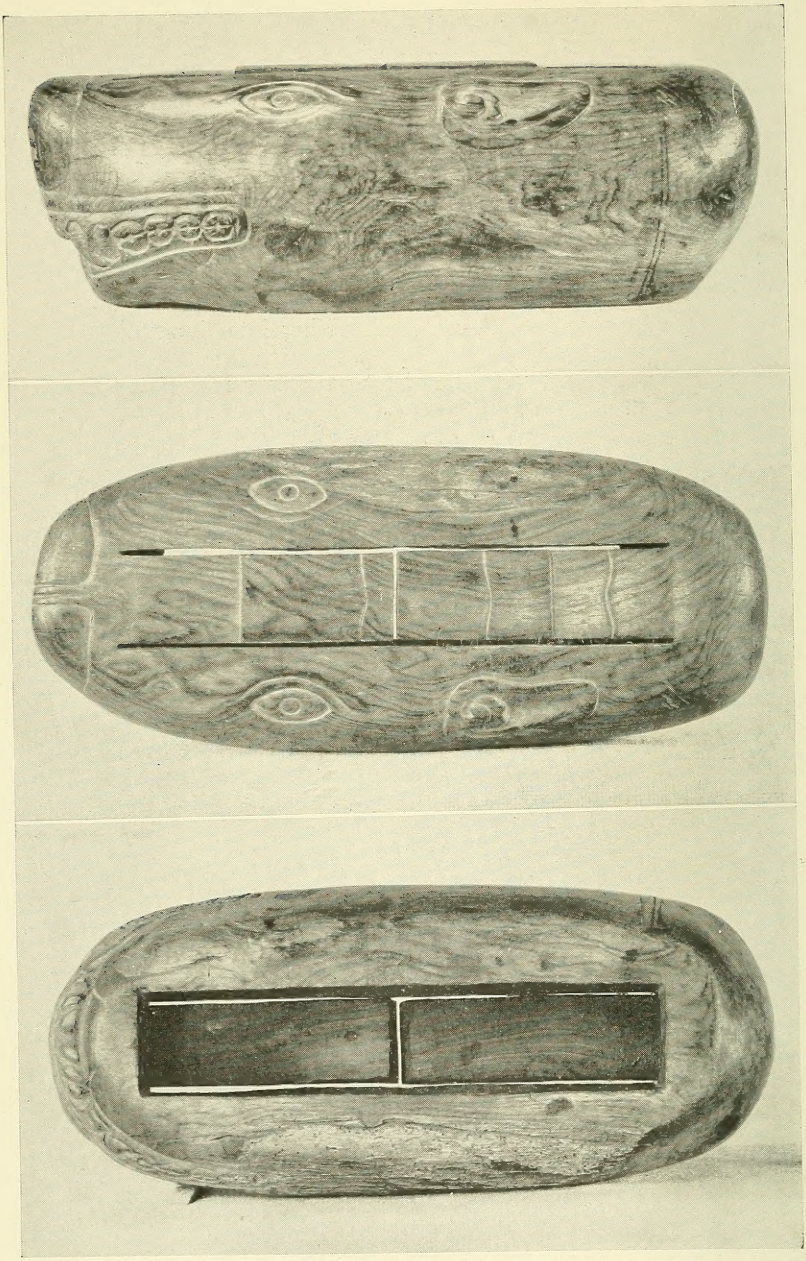

PLATE 1
A carved Aztec teponaztli.
Upper figure, side view. Central figure, top view.
Lower figure, under surface.

PLATE 2

Front view of carved Aztec drum.

In Yucatan, these wooden drums were known as *tunkuls* and according to Landa[2] "They had small drums which they played with the hand, and another drum of hollow wood (the *tunkul*) giving a deep and dismal sound; they played it with a rather long stick (having) at the end a certain milk of a tree (Indian rubber)."

The *teponaztlis* may be divided into two divisions, the plain, uncarved drums and the decorated instruments.

Of the former type Saville says, "Undecorated *teponaztlis* many of them undoubtedly made in fairly recent times are not uncommon."[3]

However, the decorated drums are relatively scarce and the existing specimens in Mexico, the United States and Europe are well known to archaeologists and ethnologists. The majority of the best ones as well as examples of fraudulent carving, are depicted by Saville. Consequently, the appearance of an unrecorded specimen is rather unique.

Recently, there was placed on exhibition in the Los Angeles Museum, at Exposition Park, a finely carved *teponaztli,* which, as far as the author knows, and as Professor Saville stated in a letter, after inspecting photographs of the specimen was "apparently never illustrated."

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[2] Ibid., p. 59.

[3] Saville, ibid., p. 64.

The drum in question was obtained in Mexico, in the state of Oaxaca in 1911 by Mr. W. E. Burk. For twenty-one years it has been in private hands and never exhibited. The photographs of the drum are here shown for the first time.

The drum is of hard wood, dark and smoothly polished. It is in an excellent state of preservation, save for an irregular patch extending over the greater portion of one side, which shows plainly the action of some wood boring insect.

From the appearance of this worm eaten, decayed section one might judge that this drum was hidden for years in some dark place, resting perhaps upon its side in a cave or room.

However, in spite of this defection, the remainder of the instrument is sound.

The *teponaztli* is twenty-six inches in length and has a diameter of eleven inches in the widest part. As may be readily seen in the side view of the drum, the top and bottom are somewhat flattened. The instrument is eight and one-half inches high.

The two tongues upon which the drummer beat to produce the sound are nine and a quarter inches long, three inches wide and vary from three-fourths of an inch to an inch in thickness.

When beaten upon with an improvised drum stick consisting of a solid rubber cork, fastened to a slender handle, the instrument produced two distinct tones. The best results were obtained by placing the drum upon the floor. When rested on a wooden box, the sound was muffled and false, but on a solid base, the sound was loud and mellow, and one can well imagine how such a drum would sound to sleepy, tired and worried Spanish soldiers surrounded by enemies in an alien land.

Apparently the carving upon the drum was done with copper and stone tools. The striations in the grooves forming the nostrils, the jaws and eyes, seem to indicate the use of sharp flakes of stone. The interior of the drum, that is the hollow portion forming the sound box as well as the triangular cuts worked from the under side, which free the sides and tips of the tongues, seem to have been done with another medium, possibly small copper chisels.

We know from various accounts and native drawings that copper chisels, copper axes and copper adzes, in addition to stone tools were utilized by the ancient Mexican workmen. Stone implements leave different marks upon wood, bone or stone than do the later iron and steel tools.

The *teponaztli* in question has been rather simply carved in the form of an animal's head. Dr. Saville is of the opinion that "the head might well be the *cipactli* marine animal connected with the calendar signs."

However, in the author's estimation, the carving seems to bear more of a resemblance to *ocelotl,* or the jaguar day sign of the Aztec calendar.

Plate 1, upper figure, is a side view of the drum showing the ear, eye and side of the jaw. Plate 2 is a view of the instrument taken from the front, showing the sharp tusks, the lolling tongue and nostrils.

A top view of the *teponaztli* is presented in Plate 1, central figure. In this illustration as well as in the lower figure in Plate 1, which shows the under side of the drum, the two vibrating tongues are clearly indicated.

The wood from which the drum is carved is very heavy. The color is dark brown, beautifully grained and bears a high polish, evidently the result of painstaking care and long usage. According to Saville[4] the principal woods used by the Nahuan carpenters "were cedar, cypress, pine, spruce, oak, laurel and other hard varieties peculiar to tropical or semi-tropical regions."

A wood favored by the Mexicans in the manufacture of their *teponaztlis* was mentioned by a Spanish writer and indicated by Saville[5] as:

"The *ahuehuete,* a cypress-like tree, is described by Hernandez in the following rather vague terms: 'The only reason why the Mexicans call this tree the *ahuehuete* is because it is accustomed to grow near the rivers where water flows, and because they make their drums of it, which in their tongue is called *huehuetl* and *teponaztli,* although others say that this is not the reason it is so called, but only because it grows near the waters, and that the wind striking (the tree or leaves) makes a noticeable sound like that of the drums used by the Indians; they do not make their drums from this tree, but of the wood of the *tlacuilolquahuitl* and of the *capolquahuitl*'."

In a letter to the author, Dr. Saville intimated that the wood from which the drum in question was made "is probably *tepeguaje* or *zapote.*"

In any event, the drum is a highly interesting specimen, one of the very few specimens of its type in the United States and well worth recording as an apparently genuine example of late Aztec craftsmanship.

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[4] Saville, ibid., p. 8.
[5] Saville, ibid., p. 8.

NOTES ON THE LARVA OF MELITAEA POLA BDV.

By Grace H. and John L. Sperry

Six larvae of *M. pola* were taken on June 30, 1931 at Sprague's in Rocky Mt. Park, Colo., at an elevation of 8,900 feet. The larvae were in their last instar and pupated from July 7 to July 16 inclusive and the first, a female, emerged on July 18. The plant food was *Pentstemon alpinus*. The description of the larva follows:

Average length, 22 mm. Depth, 4 mm. Body smooth, head hairy. Ground color of body white. Typical melitaea larva.

Head: Bilobed, bright orange yellow, hairy, ocelli covered by black spot on each side of head, small inverted brown black "v" in center of frons. Mouth parts brown-black.

Body: White, with seven rows of spines, all long, conical in shape with bristles protruding at right angles to the surface. There is also a set of small spines on each side of the abdomen, two to each segment. The dorsal row of spines are black throughout, missing on the second and third segment and double on the first segment, and are connected by a broken black dorsal line missing in most part on the last three segments. There is a lateral row of spines on each side, black throughout and connected along the dorsal edge by an irregular black line missing for the most part on the last four segments. There is a dorso-lateral row of spines on each side at about four-tenths the distance between the dorsal and lateral rows, above the lateral. These spines are orange brown tipped with black. The spines on the first segment are very small. There is a sublateral row of black spines on each side and a double set of tiny spines along the side of the abdomen at a level with the coxa of the prolegs; these are missing on the last two segments. Length of dorsal and lateral spines about 1.4 mm. Sublateral about 1 mm.; tiny spines about .6 mm. There is a purplish black band along the irregular row of tiny spines at the sides of the abdomen over all segments.

Spiracles, black. Conjunctivia, rosy brown. Abdomen white with an orange-yellow, median line throughout.

Prolegs and anal prolegs, yellow-orange.

Forelegs, orange with black tips.

EARLY STAGES OF MELITAEA LEANIRA WRIGHTII EDW. AND CALEPHELIS NEMESIS EDW. (LEPIDOPTERA)

By John A. Comstock and Charles M. Dammers

Melitaea leanira wrightii Edw.

Egg. 1 mm. long x .8 mm. wide. Color: when first laid a bright lemon yellow, changing to orange. Base rounded, top and micropylar area flattened. Ovoid in form, the top portion tapering gently to its juncture with the flattened superior surface.

The upper three-fourths of the egg is covered with longitudinal ridges, about 20 in number, between which are numerous transverse ridges, the latter rather poorly defined. The lower fourth of the surface is irregularly pitted, this feature being most noticeable in freshly oviposited eggs.

The eggs are laid in clusters on the stems of *Castilleija foliolosa* (and other Castilleijas) close to the ground.

Examples collected in San Gabriel Canyon, were furnished by Mr. and Mrs. John L. Sperry of Riverside. These indefatigable collectors are to be commended for their perseverance in observation of the habits of this elusive species. Oviposition was observed by them on June 16th, 1930.

Larva, first instar. Length 3 mm. at time of emergence.

Head, black, and bearing a sparse covering of short white hairs.

Body, light olive or straw, and bearing five rows of long white hairs on each side of the median line. Each one of these hairs arises from a raised black papillus, which gives the body a banded appearance.

The first segment bears a navicular black mark, transversely placed, on which are placed six long hairs which project over the head.

A black patch of irregular shape also occurs on the anal segment.

True legs, and all prolegs, somewhat darker than body.

Mature larva. Length, approximately 22 mm.

Head, black, covered with black vibrissae.

Ocelli, black.

Body, velvety black, and bearing the characteristic rows of glistening black branching spines. A mid dorsal row of spines is present from the fourth to caudal segments, that on the last segment being represented by a button, the others somewhat shorter

than the dorso-lateral series. Each one of these spines bears a small circlet of gray at its base. Latero-posterior thereto is an orange patch on each segment, which gives the appearance of a broken orange dorsal line.

The absence of this orange pigmentation in the mid-dorsal line produces the effect of a narrow dark mid-dorsal band.

Lateral to the orange area above noted is a wide black band, bearing two longitudinal rows of branching black spines, their bases encircled by gray, outside of which is a second series of circlets of gray dots. This feature is clearly shown in our illustration, Plate 3.

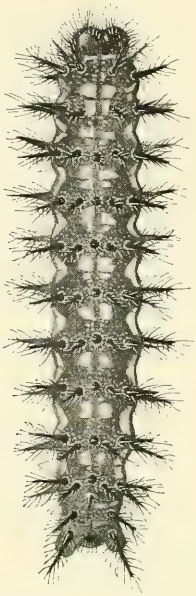


PLATE 3
Larva of *Melitaea leanira wrightii* Edw.
dorsal view, enlarged, X 3.
Drawing by Comstock.

Inferior to the double row of spines above described is a broken stigmatal band of orange and gray, the orange spots concentrated on the segmental junctures and the gray surrounding the stigmata. The latter are jet black.

Inferior to this area is a band of black sprinkled with small gray round dots, through the centre of which is placed another row of glistening black branching spines. Below this area is a narrow row of orange spots, broken by gray near each spine.

The abdominal surface inferior to this area is black, with white punctae, gradually changing to a dark olive on the mid-abdominal surface.

The usual small paired short spines occur at the bases of the prolegs, horizontally placed. The spines which are in line with these on the adjacent anterior segments are paired, but vertically placed, and the two segments posterior to those bearing the prolegs have each a small single spine.

True legs, black. Prolegs, black, with brownish-gray terminal segments, bearing fringes of brown hair.

One larva of 4.5 mm. was observed, the exact instar of which was not reported. This specimen showed most of the markings and color of the mature larva. The lowest row of spines was not as clearly defined, being more in the nature of tubercles.

Also the gray punctae scattered over the body were not as much in evidence. The prolegs were dark olivaceous, and the abdomen slightly lighter than in mature examples.

Pupa. Length, 12 mm. Greatest width 4 mm.

Ground color, silvery white, with numerous black bars, dashes and points, disposed as shown in the accompanying illustration, Plate 4, figs. *a, b,* and *c.*

a. *b.* *c.*

PLATE 4

Pupa of *Melitaea leanira wrightii* enlarged, showing (*a*) ventral aspect, (*b*) lateral aspect, and (*c*) dorsal aspect.

Most of these bars are edged with light yellow, particularly on the dorsum, this latter feature being somewhat variable.

A number of poorly defined tubercles occur on the dorsum and abdominal region, corresponding roughly in position to the more prominent spines of the larva.

The eye cases bear a brownish-yellow circlet on their anterior margin. Antennal cases black, with narrow bars of yellow. Spiracles black. Cremaster black.

One larva was parasitized by *Apanteles lunatus* Pack.

CALEPHELIS NEMESIS EDW.

This species, and *C. australis Edw.*, have been considered as merely varietal forms by a number of authors, and were so treated by the senior author in "Butterflies of California."

Careful breeding experiments, carried on over a period of years have disclosed certain larval differences and a totally different foodplant, which seems to establish definitely the validity of *nemesis* as a distinct species. The experimentation resulting in these conclusions has been largely the work of the junior author of this paper.

The early stages of *C. australis* were partially recorded in Vol. XXVII, Part 3, Bulletin Southern California Academy of Sciences.

Egg. The egg of *Calephelis nemesis* is so similar to that of *C. australis* as to render a description and drawing unnecessary. It is, on the average, slightly more robust. Fifteen eggs were secured from a female in captivity, all of which were deposited on the upper surface of a leaf of *Baccharis glutinosa* Pers. close to or directly on the midrib. This is the site usually chosen by the resting larva.

Oviposition occurred Sept. 26, 1930, and the larvae emerged on October 1st, to 4th. Two examples were raised to maturity. The young larvae frequently become adherent to the glutinous foodplant and thus perish.

Larva, final instar. Length 15 mm.

Head, gray, with buff top, profusely covered with minute silvery raised stellate nodules. The head is difficult to observe on account of the long filamentous hairs on the first segment arching over and obscuring it.

Body. Ground color, dark gray, profusely covered with silvery stellate nodules, which however are absent in certain areas along the lateral surface, thus giving the appearance of six to eight irregular blackish spots. Inferior thereto is a longitudinal line of chestnut blotches, from each one of which arises a tuft of hair.

Another line of similar tufts occurs on each side of the mid-dorsal line, but these are doubled on all segments except the 1st, 2nd, and last.

The hairs arising from these tufts or nodules are of three distinct types. A few are long, and brown in color, many are grayish-white and of medium length, while the majority are short, and of a buff shade.

The grayish-white hairs terminate in small transparent globules, which give the larva somewhat the appearance of being infested with mite eggs.

The dorsal line of tufted hairs inclines medially, thus meeting over the dorsum, while the lower series extend horizontally and lie flat on the plant food. This aspect of the larva is admirably shown on Plate 5.

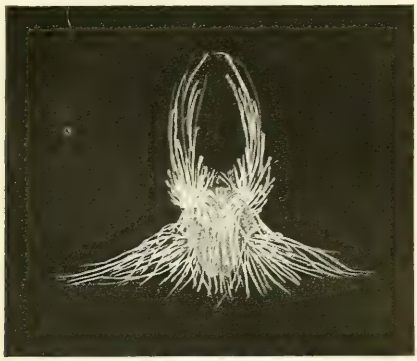


PLATE 5

Anterior aspect of larva of *Calephelis nemesis* Edw. enlarged, showing the manner in which the dorsal series of hairs arch over the medial surface of larva, while the lateral series incline infero-laterally and lie flat on the surface of food plant.

Drawing by Dammers.

Stigmata invisible.

Legs, prolegs and abdomen, pale green.

Larva, first instar.

Body, brown. The tufts of hair are represented by simple long brown hairs.

In succeeding instars, the hairs composing the tufts increase in number, and are mainly of the gray-white variety, but lack the globules at their ends. The stellate silvery nodules on the body are fewer in number compared with the last instar. The segments are more brown in aspect and yellow blotches occur above the lateral series of hair tufts.

One larva pupated Nov. 17th, the other Dec. 29th.

The lateral aspect of mature larva is illustrated in Plate 6.

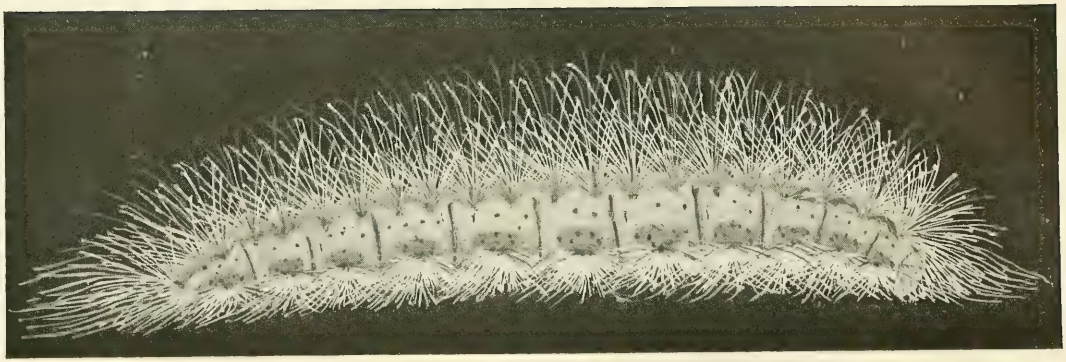


PLATE 6

Mature larva of *Calephelis nemesis* Edw. much enlarged. The legs and head of this larva are entirely obscured by the arching series of hairs.

Drawing by Dammers.

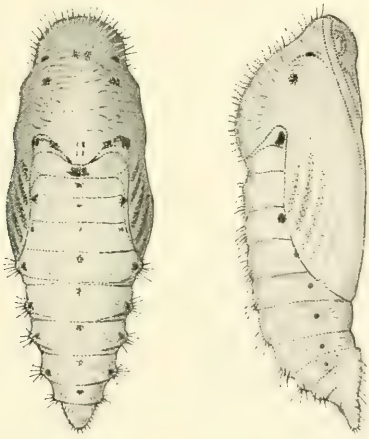
Pupa. Length, 9.5 to 10 mm. Greatest width, 3.1 mm. Color, pale dirty yellow, with a few brown dots and dashes, as shown in the illustration. Plate 7, figs. *a* and *b*.

The form approximates closely that of *C. australis,* but is slightly more robust through the center, and has a somewhat higher arch to the thorax. Short yellowish vibrissae occur over the head, dorsum and abdomen. A series of nodules, bearing short yellowish vibrissae is placed sub-stigmatally. Wing cases bare, with elongate dark shadings between the venules. Stigmata brownish-black, surrounded by an areola of light orange-brown. Cremaster, orange or yellow.

There is evidently some variation in both the form and color of the chrysalis, as one example possessed a less robust abdomen than the other, and the dorsum was colored a grayish green. There was also a greenish tinge on the ventral surface of the abdomen.

The specimen which pupated on Dec. 29, 1930, gave forth an imago on Jan. 13, 1931.

The pupa suspended on the side of the breeding cage, with a supporting girdle, and button for attachment of the cremasteric hooks. This may be characteristic of all members of the genus, though it was not observed in the case of *C. australis.*



a. *b.*

PLATE 7

Pupa of *Calephelis nemesis* Edw. enlarged.
a. Dorsal aspect. *b.* Lateral aspect.

Drawing by Comstock.

STUDIES IN PACIFIC COAST LEPIDOPTERA
(Continued)

By John A. Comstock
Associate Director, Los Angeles Museum

Danaus berenice strigosa Bates.

This race of D. berenice is the common form in Southern California. Its metamorphosis is presumably the same as for the parent species, *berenice,* which has been described in detail by a number of writers.

No illustration is available in any readily accessible work, and we are therefore showing a drawing of the larva (Plate 8) and pupa (Plate 9).

The species has been reared on several varieties of Asclepias, and on *Funastrum lineare heterophyllum* Macbr.

a. *b.*

PLATE 8
Larva of *Danaus berenice strigosa.*
Fig. a. Head of larva, greatly enlarged.
Fig. b. Larva, lateral view.

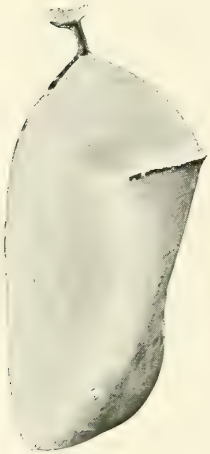


PLATE 9
Pupa of *Danaus berenice strigosa,*
side view, enlarged.

Aglais californica Bdv.

In spite of the great abundance of this species in certain seasons, and the recorded occurrence of the larvae in such numbers as to defoliate the foodplant (*Ceanothus*) over wide areas, there seems to be no available illustration of the various phases of its metamorphosis.

Through the courtesy of Mr. and Mrs. Oliver T. Young, of Fillmore, Calif., we were supplied with mature larvae and pupae which made possible the drawings that are presented on Plates 10 and 11.

This is one of our native species which occasionally occurs in migrating swarms through our mountains. It is suggested that lepidopterists should make published records of the dates and localities where these swarms appear, and endeavor to determine the factors which are responsible for the species' almost total disappearance in certain localities for a period of time, subsequent to its swarming.

PLATE 10
Larva of *Aglais californica* enlarged.

PLATE 11
Pupa of *Aglais californica*, dorsal and lateral aspects, slightly enlarged.

GONIURUS PROTEUS L.

The larva and pupa of this species was figured on page 205 of our "Butterflies of California." Scudder has also given beautiful figures of the egg, larva and pupa in his "Butterflies of New England," but the latter work is so rare as to be out of reach of the average collector. We are therefore reproducing the egg on Plate 12.

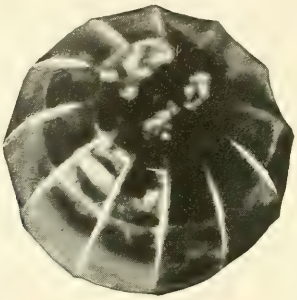


PLATE 12
Egg of *Goniurus proteus*,
highly magnified.

The single example from which this photograph was made reached us through the courtesy of Comm. C. M. Dammers of Riverside, Calif. It was laid September 1, 1931, on Buckeye bean, where it was deposited on the under surface of the leaf.

The summer and fall of 1931 was a remarkable season for the occurrence in Southern California of a number of species which ordinarily do not range north of the Mexican line. Not only was *G. proteus* abundant, but many captures were recorded of *Sesia titan* Cram. and *Erinnyis ello* L., two species which seldom venture into California.

DR. ANSTRUTHER DAVIDSON

In the death of Dr. Anstruther Davidson, the Southern California Academy of Sciences experiences the loss of one of its oldest, most useful and most valued members. He was one of the founders, and remained an active associate and fellow of this institution for forty-one years. He was the first Treasurer, the second President, and throughout the whole time a member of the Board of Directors. Aside from his profession, Dr. Davidson found a field of life-long study in Botany and Entomology, and his papers on these subjects were an established feature of the Bulletin of the Academy, attracting world-wide attention. He served on the Board of Governors of the Museum of History, Science and Art from its beginning, as one of the representatives of this Academy, for a period of twenty-two years. His interest in and devotion to Science was greater than his profession, and his special lines of study, and he rendered just appreciation to every branch that called for attention and encouragement. In every sense he was a broad man of science; indifferent to personal advantage or credit, but devoted to the advancement of human knowledge. As an associate in our long and arduous work we ever found him a courteous companion, a wise counselor, a staunch friend.

Be it resolved by the Academy that this tribute be spread upon the minutes, and a copy thereof be sent to the family of our deceased brother.

Dr. Davidson was born in Watten, Scotland, February 19, 1860, the son of George and Ann (Macadam) Davidson. He received his academic education in the University of Glasgow, securing the degrees of M. B., and C. M. in 1881, and the M. D. degree in 1887. He came to Los Angeles in 1889 and established a practice which, through the succeeding years, won him an enviable reputation as a dermatologist.

He was associate professor of Dermatology in the University of Southern California, and a corresponding number of many scientific bodies. He published the "Plants of Los Angeles County" in 1892, and the "Flora of Southern California" in 1923. Many new species of plants were discovered and described by him in the Bulletin, Southern California Academy of Sciences.

He married, June 24, 1897, Alice Merritt. Two sons survive him,—Ronald A. and Merritt T. He died in Los Angeles, April 3, 1932.

Wm. A. Spalding.

The work of the Southern California Academy of Sciences is carried on entirely through the generosity of private citizens, who are sufficiently interested in the advancement of education and cultural endeavor to donate funds or make bequests to the Academy. As a guide, in the matter of bequests, for those who plan to further this program, the following forms are suggested:

Form of Legacy

To be used when it is desired to leave the Academy any personal property, such as money, stocks, bonds, works of art, or other objects of value.

I give and bequeath unto "Southern California Academy of Sciences," of the City of Los Angeles, the sum of..... Dollars: To have and possess the same unto the said "Southern California Academy of Sciences," its successors and assigns, to the uses, dispositions and benefits thereof forever.

Form of Devise

To be used when it is desired to leave real estate to the Academy.

I give and devise to "Southern California Academy of Sciences" of the City of Los Angeles, (..... here describe the property or ground rent.....), together with the appurtenances, in fee simple, and all policies of insurance covering said premises, whether fire, title or otherwise, free from all taxes: To have and to hold the same unto the said "Southern California Academy of Sciences," its successors or assigns forever.

BULLETIN of the SOUTHERN CALIFORNIA ACADEMY of SCIENCES

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Care of Los Angeles Museum, Exposition Park,

Los Angeles, Cal., U. S. A.

Publications of the
Southern California Academy of Sciences

The Academy has published to date the following:

PROCEEDINGS. 1896 to 1899. Six numbers—Vol. 1, Nos. 1 to 6.
MISCELLANEOUS BULLETINS issued under the imprint of the Agricultural Experiment Station—1897 to 1907. Ten numbers.

All issues of the above are now out of print.

■ ■

Bulletin of the
Southern California Academy of Sciences

Began issue with Vol. I, No. 1, January, 1902. Issued ten numbers in 1902, nine numbers in 1903, 1904, 1905; three numbers in 1906. Issued two numbers annually from 1907 to 1919, both inclusive (except 1908—one issue only). Issued four numbers (January, May, July and October) in 1920.

The 1921 issues are: Vol. XX, No. 1, April; Vol. XX, No. 2, August; Vol. XX, No. 3, December.

The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

The 1923 issues are: Vol. XXII, No. 1, March; No. 2, July.

The 1924 issues are: Vol. XXIII, No. 1, January-February; No. 2, March-April; No. 3, May-June; No. 4, July-August; No. 5, September-October; No. 6, November-December.

From 1925 to 1931, including volumes XXIV to XXX, three numbers were published each year. These were issued as No. 1, January-April; No. 2, May-August; No. 3, September-December, for each volume.

All of the issues listed on previous page are now out of print, with the exception of the following, which may be secured from the Secretary of the Academy at the appended prices:

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"	24,	"	3.	September,	1925	.25
"	25,	"	1.	January,	1926	.75
"	25,	"	2.	May,	1926	.25
"	25,	"	3.	September,	1926	.25
"	26,	"	1.	January,	1927	.25
"	26,	"	2.	April,	1927	.25
"	26,	"	3.	September,	1927	.25
"	27,	"	1.	January,	1928	.25
"	27,	"	2.	May,	1928	.25
"	27,	"	3.	September,	1928	.25
"	28,	"	1.	January,	1929	.25
"	28,	"	2.	May,	1929	.25
"	28,	"	3.	September,	1929	.50
"	29,	"	1.	January,	1930	.25
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"	29,	"	3.	September,	1930	.25
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Southern California Academy of Sciences, Care of Los Angeles Museum, Exposition Park, Los Angeles, California.

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CONTENTS

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Southern California Academy of Sciences

A NEW GENUS AND SPECIES OF PHALAENIDAE* FROM CALIFORNIA

By Foster H. Benjamin

Bureau of Entomology, United States Department of Agriculture

The notes and descriptions in this paper are the result of the identifications of specimens submitted by Dr. John A. Comstock of the Los Angeles Museum.

One genus and one species of North American moths are described as new and the transfer of one other genus and three species is discussed.

Trichocerapoda, new genus.

Type: *Trichocerapoda comstocki,* new species.

Antenna of male serrate and fasciculate; of female simple, ciliate. Eye large, rounded, hairy; with lashes from behind and with a few scales resembling lashes from near the base of the antennae. Palpi obliquely upturned, fringed with long scales and hair-like scales. Proboscis fully developed. Frons slightly excurved, roughened. Head and thorax clothed with bi- and trifurcate scales, collar tending to form a slight ridge, metathorax with a strong paired crest. Fore tibia with a curved claw on the outer side. Fore tarsus with rather evenly spaced claw-like spines on the joints. Abdomen with dorsal crests on the first three segments. Fore wing rather narrow, the apex somewhat produced, the termen obliquely curved; veins 3, 5 from near angle of cell; 6 variable from areole distad of the discocellular vein in the male, from upper angle in the female; 9 from 10 anastomosing with 8 to form the areole; 11 from cell. Hind wing with veins 3, 4 from angle of cell, 5 obsolescent from near middle of discocellulars; 6, 7 shortly stalked from upper angle; 8 anastomosing with the cell near base only.

The present genus falls in Hampson's "Keys" (Cat. Lap. Phal. B. M.) into a small group of the Hadeninae containing only *Barathra, Thargelia,* and *Hypobarathra,* from all of which it be immediately sorted by the presence of the claw-like tarsal spines, as well as by the combination of the roughened frons with the dorsal abdominal crests.

"Cerapoda" oblita Grote has a similar claw on the fore tibia as well as the claw-like tarsal spines, and possesses hairy eyes, the hair rather difficult to see. Temporarily it may be placed in

*Noctuidae of Authors.

Trichocerapoda. "*Cerapoda*" or "*Calophasia*" *strigata* Smith also has hairy eyes, has the chitin of the fore tibia somewhat produced distally, and possesses claw-like spines on the fore tarsus. Pending further studies it may be placed in *Trichocerapoda,* where it so agrees with *comstocki* in habitus and maculation that sorting of the two species will be difficult except on the basis of the structures discussed in a following paragraph.

Cerapoda Sm. (type *obliqua* Sm.) has a few obsolescent hairs on the eyes and will also have to be transferred to the Hadeninae. It is easily sorted from *Trichocerapoda* by the absence of normal hair on the eyes, by the absence of any indication of a claw on the fore tibia, and by the presence of terminal heavy claws on the segments of the fore tarsus, the basal joint with two curved claws on the basal half.

TRICHOCERAPODA COMSTOCKI, new species.

Agrees in size, shape, coloration, and maculation with pale specimens of *Cerapoda strigata* Smith, with similar frons and tarsi, the male antenna somewhat more serrate and fasciculate, the uncus broader at the tip, the harpe less trigonate, eye with more strongly developed hair, fore tibia with an outer claw.

Head, thorax, and fore wing white, powdered with black scales. Abdomen luteous white powdered with black scales. Fore wing with the transverse markings obsolescent except for the subterminal line of the female which is obliquely excurved from near apex to near the base of the reniform, thence as a weak W-mark, and incurved around a dark tornal blotch. The male has the subterminal line indicated by a triangular dark patch on the margin distad of the cell. Basal line black, not conspicuous; claviform elongate, but poorly defined; orbicular elongate, occupying most of the cell mesad of the reniform, and sometimes contiguous with that spot; reniform strongly bent, not conspicuous, merging with the ground color except for a central darker crescent; veins indicated as fine black lines; fringe somewhat luteous at the base and paler at the tip, with a broken blackish interline giving a checkered appearance. Hind wing; of male white, the terminal margin and veins powdered with black scales, fringe white; of female more or less suffused with fuscous, the fringe with dark interline. Beneath: male white, with scattered black scales, the fore wing with a blackish bar on the discocellulars; female similar but with the dusting of black scales more noticeable, especially on the terminal areas of all wings.

EXPANSE: ♂ 27-29 mm.; ♀ 27-29 mm.

TYPE LOCALITIES AND NUMBER AND SEXES OF TYPES: Holotype ♂, Snow Creek, Coahuilla Valley, Nov. 2, 1930; 4 ♂ Paratypes, same data: Allotype ♀, Indian Wells, Oct. 15, 1921 (K. R.

Coolidge); 1 ♂, 1 ♀ Paratypes, Indian Wells, Oct. 30 and Oct. 16, 1921; 1 ♂ Paratype, Palm Springs, Oct. 22, 1927; 4 ♂, 1 ♀ Paratypes, Indio, Oct. 31, 1927, Nov. 4, 7 and 10, 1923, and Oct. 20, 1921; all from California.

TYPES: U. S. N. M., except 6 ♂ 2 ♀ Paratypes returned to Dr. Comstock.

NOTES: Described from eleven male and two female specimens submitted by Dr. John A. Comstock for identification, and one female from the U. S. National Museum Collection. Cat. No. 44075 U. S. N. M.

NEW PHALAENIDAE* FROM THE SOUTHWESTERN PART OF THE UNITED STATES (LEPIDOPTERA)

By FOSTER H. BENJAMIN

Bureau of Entomology, United States Department of Agriculture

The descriptions in this paper are the result of the identification of specimens submitted by Dr. John A. Comstock of the Los Angeles Museum.

One genus and two species of North American moths are described as new.

TRICHOCLEA MOJAVE, new species.

Agrees in size and habitus with *Scotogramma gatei* Smith, with similar but less pronounced markings on the fore wing, due to the presence of somewhat more fuscous powdering which tends to obscure the sordid luteous tintings.

Male antenna simple, ciliated, with a longer seta from each side of each joint; eye large, rounded, with long hair; frontal bulge approximately equal to half the width of the eye, roughened, with a roughened transverse ridge and a broader roughened vertical ridge; clypeal plate somewhat produced; all tibiae lacking spines or claws; fore tarsus with long, heavy, curved outer claws, the first joint with three claws on the basal half, one distally, and with a spine between the basal half and the terminal claw, all the remaining joints spined and each equipped with an outer terminal claw except the last joint, which possesses

*Noctuidae of Authors.

the normal claws; mid and hind tarsi normally spined; venation normal except that veins 6 and 7 of the hind wing are well stalked in all the types and 5 is from well below the middle of the discocellular vein, somewhat stronger than normal, and almost parallel with vein 4, but the lower part of the discocellular is strongly recurved, making the venation definitely trifid.

Head and thorax clothed mainly with broad scales, intermixed with a few hair-like scales and hairs, black, white, and sordid luteous, so mixed as to appear to be a dull brownish ashen with obscure blackish and pale lines and interlines. Fore wing presenting a dull powdery ashen appearance due to black and white scales which are dusted over a sordid luteous-brown ground; the ordinary lines and spots obsolescent, but indicated as follows: basal dash consisting of a few black scales; claviform indicated by black scales which outline its position; orbicular and reniform almost lost, the former indicated by a slightly darker central powdering, the latter by powdering on the bases of veins 4 and 5; the transverse posterior line indicated by only a few blackish scales; the subterminal line mainly indicated by a slightly paler shade outwardly defined by heavier blackish powdering and inwardly by obsolescent blackish dashes between veins 2-3, 3-4, and 4-5; veins black lined; a pale point on the costa indicating the beginning of the transverse anterior line; a similar pale point is above the reniform and probably indicates the beginning of the transverse posterior line; fringe luteous white tinged with gray, interlined and checkered with fuscous gray. Hind wing white; without discal spot; with some fuscous powdering which grays the longitudinal veins, and the costal and terminal margins; a broken, thin, black terminal line; fringe whitish, luteous at base, interlined with fuscous gray. Beneath: white, sparsely powdered with fuscous gray, which is emphasized along the costal and terminal margins, on the discocellulars of the fore wing, and more or less darkening the longitudinal veins; fringes as on upper side.

Expanse: 34-35 mm.

Type locality: Mojave Desert, Calif.

Number and sexes of types: Holotype ♂, 3 ♂ Paratypes, all April 20, 1930 from "Coll. J. A. Comstock."

Types: Holotype ♂, 1 ♂ Paratype, in U. S. N. M.; 2 ♂ Paratypes returned to Dr. Comstock, Cat. No. 44108, U. S. N. M.

Policocnemis, new genus.

Type: *Policocnemis ungulatus,* new species.

Antenna with pectinations to the tip in both sexes; proboscis small; palpi obliquely upturned, slender, hairy, short, not reaching the middle of frons, the third joint minute, obscured; frons

flattened, scarcely projecting, at vertex its width approximately equal to the width of the eye, narrowed toward clypeus; clypeal plate strongly produced; mesothorax with a transverse band of metallic-black scales; metathorax with a large paired tuft of similar scales; abdomen without crests, the female with a strong caudal disconcolorus tuft of scales mixed with hair completely clothing the terminal segment; fore tibia with a strong claw on inner side, the edge of this claw forming a shovel-shaped ridge on the outer side; mid and hind tibiae unarmed save for the normal spurs. Fore wing with the apex rounded, the termen evenly curved and not crenulate; veins 3, 5 from near lower angle of cell; 6 from just below upper angle; 9 from 10 anastomosing with 8 to form the short areole; 11 from cell. Hind wing with veins 3, 4 from lower angle of cell, or shortly stalked; 5 from just below middle of discocellulars; 6, 7 stalked from upper angle; 8 anastomosing with cell near base only.

The present genus keys to Oxycnemis in Hampson and has a similar habitus, markings, and peculiar thoracic tuftings; but it may be easily differentiated by the pectinate antennae, and the terminal abdominal tuft of the female, a tuft similar to that possessed by *Andropolia* Grt. The claw on the fore tibia is similar in shape to the claw on the fore tibia of specimens of *Fala ptychophora* Grote.

Policocnemis ungulatus, new species.

Fore wing whitish, powdered with black scales and appearing gray except in the cell and the costal region, or where marked with black; veins black; basal line absent; the transverse anterior line black, outwardly oblique from costa through the cell, absent below, with a mesial tooth; claviform elongate, outlined by a thin line, its distal portion suffused by a black shade which extends from vein 3 to the apex as a triangle inside of the subterminal line; the transverse posterior line black, thin, excurved in radial region, slightly bent inwardly between veins 4 and 6, thence abruptly rounded and proceeding to near the tip of the claviform where it becomes obsolete; subterminal line is indicated as a narrow pale shade; terminal line whitish; fringe fuscous at base and tip, interlined and interrupted with whitish. Hind wing of male white; of female dull fuscous brown, somewhat paler basally; fringe of male almost pure white, somewhat discolored at the base; fringe of female luteous at base, with a faintly darker interline, and white tip. Beneath: fore wing dull fuscous, gray at apex and along the outer margin; hind wing of male white, powdered with only a few fuscous scales throughout the costal region; of female white, more or less dusted with dull fuscous brown which tends to form an obsolescent but broad median band.

Expanse: ♂ 26-29 mm. ♀ 33 mm.

Type localities and number and sexes of types: Holotype ♂ and Allotype ♀, Alpine, Texas, 22-31 Aug. 1926, and 8-14 Sept., 1926 (O. C. Poling); 3 ♂ Paratypes, Shelter Cave, N. Mex., July 21, 1930.

Types: Holotype ♂, Allotype ♀, 1 ♂ Paratype in U. S. N. M.; 2 ♂ Paratypes returned to Dr. Comstock. Cat. No. 44109, U. S. N. M.

Notes: The two specimens from Alpine, Texas, are part of the material obtained from the William Barnes Collection; the three males from New Mexico were recently received from Dr. Comstock for identification.

Ed. Note: All material reported as returned to Dr. Comstock is permanently deposited in the collection of the Los Angeles Museum.

METAMORPHOSES OF FIVE CALIFORNIA DIURNALS (LEPIDOPTERA)

By John A. Comstock and Charles M. Dammers

Anthocharis cethura F. & F.

Females of this species were observed in April of this year ovipositing on *Sisymbrium pinnatum* and *Thelypodium longirostris,* in the vicinity of Phelan, Mojave Desert. An imprisoned female laid 5 eggs on April 4th, which emerged April 7th.

The eggs are usually laid singly on the blossoms, tucked in at the base, or upon the stems close to the blossoms. Occasionally, however, they are placed on the leaves. The young larvae feed preferably on blossoms, but later transfer to the seed pods.

egg: Tall, cylindrical, of the usual Anthocharid type, tapering at both ends: slightly more robust than the egg of *lanceolata* or *sara.* Base slightly flattened.

There are from 13 to 19 longitudinal ribs or ridges, between which are deep grooves which are crossed by numerous low transverse ridges.

Color, orange yellow. Size, averaging about 1. mm. tall by .4 to .5 mm. through middle portion.

larva: first instar. Length 1.5 mm.

Head and appendages black. Body, yellow.

Five rows of simple hairs occur on each side of the mid-dorsal area. Each hair arises from a papillus that is slightly darker than the body of the larva. The head also bears a few scattered black hairs, discernible only under magnification.

First moult, April 11th. Duration of first instar, 7 days. There is probably some variation as to the time involved.

second instar.

Body color, greenish yellow, the head concolorous with body.

The same series of hairs is present, but the prominent papillae from which they arise show a lighter coloration. There is a suggestion of a light sub-stigmatal line.

Ocelli, black. Tips of true legs black, the remaining portion of legs and also all prolegs, concolorous with body. The single example under observation moulted April 14th.

The succeeding instars, up to the mature stage, show little change except that the hairs become progressively smaller, and the lateral white or creamy-white line more prominent, with a brownish upper edging. Some examples show a narrow brown mid-dorsal stripe.

MATURE LARVA.

The hairs over the dorsum are now short, dark, and very numerous, and arise from black prominent papillae. On the abdomen these hairs are light. Head, green with a slight overcast of maroon.

A narrow white stigmatal line is present, edged superiorly with brown or purplish brown. The body color is at first a dark green over the dorsum and a lighter green on the abdomen. As the instar advances a change of color occurs. The dorsal area becomes ivory, with heavy black punctae, giving a mauve cast. Yellow transverse bands begin to appear at the segmental junctures.

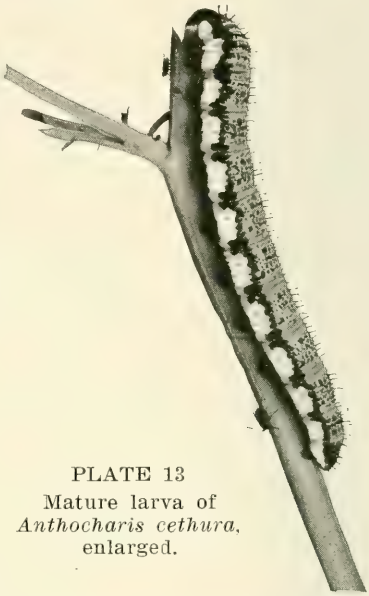


PLATE 13
Mature larva of *Anthocharis cethura*, enlarged.

A yellow or orange point also appears at each segmental juncture on the stigmatal white line and grows progressively larger. The stigmatal white line, between these yellow points, grows progressively larger, wider and more conspicuous and the head becomes a darker purple. Also there begin to appear numerous black points between the yellow bands of the dorsal segmental junctures. This change continues until the orange spots on the stigmatal line become quadrate and paired each side of the segmental crease, with a heavy black area above, and the mauve edging above the white stigmatal areas fades to white, thus creating a wide, interrupted stigmatal band, superior to which is a wide black area. The abdomen changes to grey, then to speckled, and finally to a black, while the legs and prolegs are concolorous with the abdomen.

The head becomes a solid black except for an extension of the white lateral band onto the cheeks. Ocelli, black and prominent. Spiracles, dirty white.

The illustration, Plate 13, shows this terminal color phase, shortly before pupation.

Length: 23 mm.

Pupated April 27th. Pupation occurs on the foodplant, with the usual girdle, and caudal button, the head always pointing upward.

PUPA: Strongly arched over the dorsum, with a forward extension of the head and a robust straight "beak" for the palpal

cases. The dorsal thoracic-abdominal juncture is more deeply incurved than in any other species thus far described. Wing cases, strongly marked with dark bands along the venules, and edged with lighter areas. A poorly defined mid-dorsal dark stripe is present, and a light interrupted supra-stigmatal band occurs on the abdominal area. The ground color varies from a mottled blackish gray to a light old wood color.

Illustrated on Plate 14.

In addition to the food plants above noted, the larva has been taken on *Streptanthus inflatus*. The species is single brooded.

PLATE 14
Pupa of *Anthocharis cethura*, lateral view, enlarged.

EUCHLOE CREUSA LOTTA BEUT.

This species has been observed to oviposit on the same food plants as are recorded for *A. cethura*. Specimens have been reared in captivity on *Sisymbrium altissimum*.

Eggs were secured this past spring from the Mojave Desert and the following notes recorded.

EGG. Similar to that of *sara* and *cethura*: lemon yellow. Laid singly on the food plant. Emerged in 3 days.

The first larval instars were indistinguishable from *A. cethura*. As maturity approaches a marked difference occurs. The first instar occupied 4 days and the second was of only 3 days duration.

PLATE 15

Larva of *Euchloe creusa lotta*, enlarged.

MATURE LARVA. Length 24 to 28 mm.

Ground color, green. Covered with numerous raised purplish punctae, bearing each a short dark bristle, those on the abdominal surface being longer and colorless.

There is a faint brownish or purplish mid dorsal stripe, due largely to the enlargement of the purplish areolae at the bases of the punctate papillae in this region. These papillae are thickly scattered over the entire body of the caterpillar above the stigmatal line.

This latter line is wide and clearly marked, being creamy white in color, and edged above with a purplish or brownish-pink band.

Abdomen, bright green. Head, bluish-green, thickly covered with small purplish-black nodules and bearing a covering of colorless hairs which are noticeably longer in the region of the mouth parts. Ocelli black. Mouth parts green.

True legs green except for the tips of terminal joints which are brown. Prolegs concolorous with body. Spiracles white. See Plate 15.

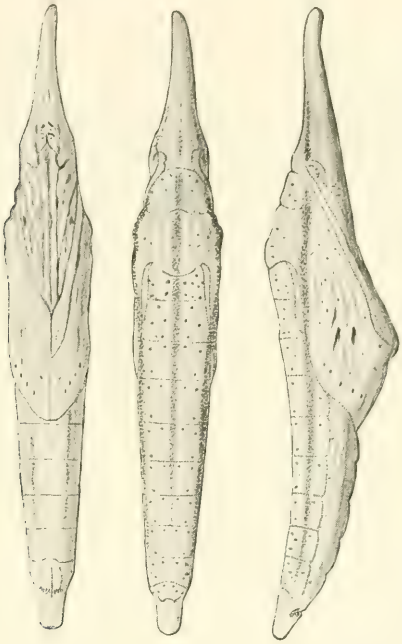
The larvae feed only on the seed pods of the food plant. A short time prior to pupation they turn a mottled dark maroon over the dorsal and lateral surface above the stigmatal line. Pupation occurs in the same manner as with *A. cethura*.

PUPA. Length 17 to 20 mm.

The color varies from a light straw through light brown or pinkish brown to dark wood brown. Sub-cylindrical, the thorax only slightly protruded: abdomen tapering regularly and gently: venter much less acutely protruded in its center than with *cethura*. The palpal cases protrude forward in a snout which is more gradually tapering and pointed than is the case with the above compared species. Two examples show a slight downward curve to this snout, but in the majority of cases it is straight. A mid-dorsal narrow dark stripe is always present, and a wide stigmatal series of dark blotches and broken lines occurs on several. The lines of the venules on wing cases are clearly discernible, as will be noted in our illustration. About

20 days elapses from the emergence of egg to pupation, and only a single brood is produced in a year.

The pupa is illustrated on Plate 16.



a. *b.* *c.*

PLATE 16

Pupa of *Euchloe creusa lotta*, enlarged.
a. Ventral aspect. *b.* Dorsal aspect. *c.* Lateral aspect.
Drawing by Comstock.

APODEMIA PALMERII MARGINALIS Skinner.

Edwards, in his "Butterflies of North America," briefly describes the egg and first larval instar of *"Lemonias" palmerii* and shows figures of the egg and young larva. His illustration of the egg is somewhat misleading and does not conform to our observations on the California race, *marginalis*.

Eight eggs of this species were secured from a female in captivity, captured at Fish Springs, Imperial Valley, Calif., on Oct. 25, 1931. These emerged on Nov. 4th. The eggs are probably deposited singly, on the young tender leaves of the food plant, Honey mesquite (*Prosopis julifloria* v. *glandulosa* Ckll.). In captivity the females laid on any variety of plant supplied them, but on emergence, fed only on the mesquite.

EGG: A flattened hemisphere about half as tall as the base measurement, the micropyle acutely depressed, not rounded on the edges. The surface is covered with a regular network of hexagonal cells. The raised walls separating these cells do not show the raised nodules mentioned by Edwards, and shown in his illustration. Ground color of egg, light green, of the partitions, translucent white.

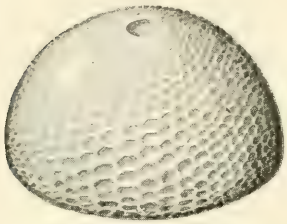


PLATE 17

Egg of *Apodemia palmerii marginalis*, highly magnified.

Drawing by Comstock.

The egg is illustrated on Plate 17.

LARVA, FIRST INSTAR: pale translucent green, with gray-brown patches running in vertical lines on each segment. Four rows of tufted hairs run longitudinally, the upper series composed each of a single erect dark brown hair, and two to three short colorless hairs. The lower series are composed of colorless hairs only. These tufts arise from tumid processes, arranged one to each segment. On the first segment is a fringe of hair which inclines over the head.

Head, yellow or brownish-yellow; obovoid, bilobed, slightly pubescent. Ocelli and mouth parts, brown.

Successive instars: body pale bluish-green, faintly mottled with white and pale brown. A narrow, white band runs longitudinally below the upper series of hair tufts.

Six rows of hair tufts are present, three on each side arranged longitudinally. The upper row is composed of an admixture of dark brown, and white stiff hairs. The next lateral row is similar but contains more of the white hairs. The inferior row is composed of long white soft drooping hairs.

The lateral overlapping fold is white. Stigmata, white. Abdomen, pale green. Legs, colorless with black markings. Prolegs and anal proleg, green with brown claspers.

Head, white, with black blotches, covered with long white hairs.

There is a narrow black bar across the top of the first segment.

MATURE LARVA: length, extended, 13 mm.

Body a pale bluish-green. A lemon-yellow mid dorsal line is present, as is also a similar line running longitudinally below the upper row of hair tufts.

Six rows of hair tufts are present, as in former instars, one tuft to a segment in each line. The upper tufts contain a few dark hairs on the first four segments, interspersed in white hairs, the remaining hairs all being white.

The surface of the body is sparingly covered with short white vibrissae.

The lateral overlapping fold is yellowish-white.

Stigmata, white. Abdomen, pale green. Legs, pale green with colorless tips. Prolegs and anal prolegs, pale green with colorless claspers. Ocelli, black.

The mature larva is shown in dorsal aspect on Plate 18.

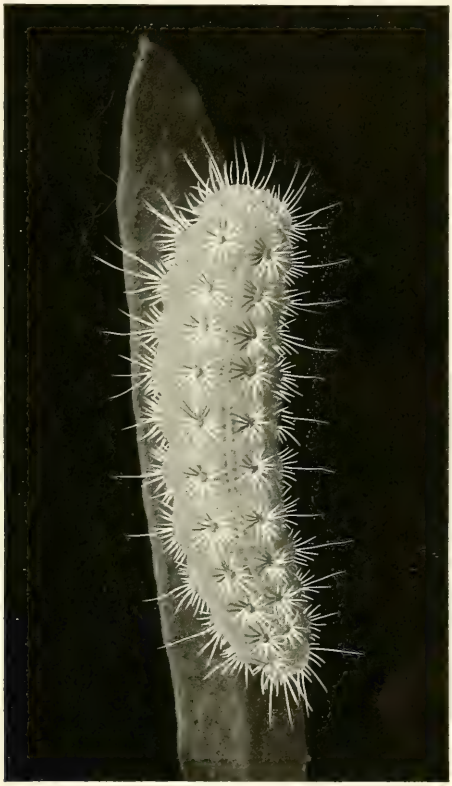


PLATE 18
Larva of *Apodemia palmerii marginalis*.
dorsal view, enlarged.

Pupation takes place on the food plant in a silken nest formed by drawing a few leaves together. This occurs in April for the spring brood.

PUPA. Length 8 mm.: greatest width through thorax 2.8 mm. Predominant color a pale bluish green, the wing cases slightly lighter and turning to a pale straw, with wing pattern discernible on a dull white, before the imago emerges. A yellowish white line extends from the mid-thoracic area to the caudal end

on each side of the mid-dorsal area. Eye cases yellow, and very prominent. The head, thorax and body are covered with short white or colorless pile.

Cremasteric hooks, minute and colorless. Spiracles minute, brown centered.

Pupa, illustrated on Plate 19.

The larvae of this species spend their entire life, except when feeding, thoroughly concealed in a silk nest formed by drawing two leaflets together. In early February they were only in their third instar, having fed only occasionally during the winter, but never going into true hibernation. As soon as the new spring growth of the food-plant was given them, they rapidly reached maturity. Imagos emerged April 19th to early May, 1932. There are two broods in a year.

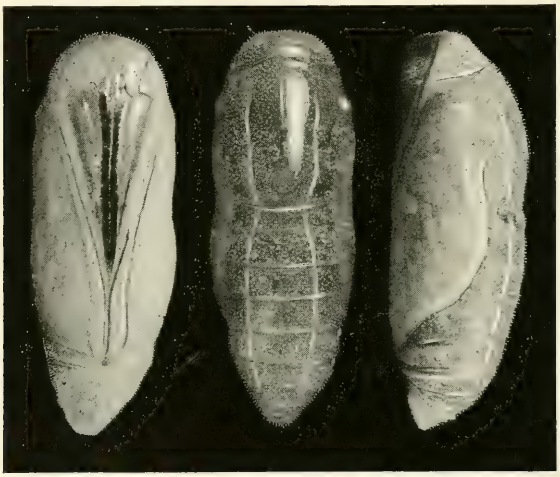


PLATE 19
Pupa of *Apodemia palmerii marginalis*, enlarged, showing ventral aspect (at left), dorsal aspect (center) and lateral view (right).

MITOURA LOKI. Skinner.

An egg of this species was secured April 2, 1930, by Theodore Childs, Jr., in the Gavilan Hills, near Riverside. At a later date additional examples were obtained in the same region.

EGG. Delicate light green, with the raised portions of a lighter shade almost approximating white. The form is similar to that of *Mitoura siva juniperaria*, as illustrated in "Butterflies of California," but with the following slight divergences.

The raised points are not as clearly defined in the region of the micropyle, and are more pronounced at the outer circumference of the egg. These points do not show a tendency to regular

alignment to the same extent as in the egg of *juniperaria*. Period in ovum, 5 days. The eggs are laid singly on the tender tips of the plant.

LARVA, first instar. Yellow: covered with long curved grayish hairs. Head, yellow, with black ocelli and mouth parts. Length, at time of emergence, about 1:25 mm. On the second day the larva assumed a greenish shade. Duration of instar, 6 days.

SECOND INSTAR.

Bristles now relatively short and profuse. Larva a darker green. Head green; ocelli black. Duration of instar, 10 days.

THIRD INSTAR.

The color is a mottled green and yellow-green, simulating the juniper stems. The segments are thrown into numerous prominent folds, further aiding in this simulation. The pile is greatly reduced in length. Head retractile.

Further records of the moults was not observed, but the final instar shows the following characteristics.

PLATE 20
Mature larva of *Mitoura loki*, enlarged.

MATURE LARVA. Length, 22.5 mm.

Form, of the usual slug type, as illustrated on Plate 20. The segmental creases are deep, throwing each segment into rounded relief. These segments are also thrown into a series of protrusions and depressions, in regular form, somewhat as are the twigs of the juniper. Ground color of body, vivid green, with the raised lobulations a darker green. A lemon-yellow broken longitudinal line, or series of irregular crescents, occurs each side of the median dorsal area. A similar line, creamy-white, is also present along the lateral edge of the overlapping fold.

The body is covered with minute brown pile, which gives the larva a velvety appearance.

A small diamond shaped cervical shield occurs on the first segment in the median line. This is of a soiled white color.

Abdomen, concolorous with body. Legs, green, with pink terminal hooks. Prolegs and anal prolegs, green, with pink claspers.

Head, greenish brown, with gray mouth parts. Spiracles, brownish red.

Pupation takes place on the food plant, suspended from a silk button, and supported by a delicate silk girdle.

PUPA. Robust, thickest through the mid-abdominal region; dark chestnut-brown, somewhat mottled, and covered with a chest-

nut pile except for the wing cases and facial portions. The surface is heavily creased and irrocated, particularly over the anterior portions. The segmental creases and junctures are deep and clearly defined. Breadth at widest point equals half of the length. See Plate 21.

The imago emerged June 4th, making a duration for the entire life cycle of slightly over two months.

This species is doubly brooded. The first brood appears in April or May, and the second flies in late June and July. The type locality is Jacumba Hot Springs, San Diego County, but captures have lately been recorded from Chino Canyon, near Palm Springs, Riverside County; Morongo, and Warren's Wells, San Bernardino County; and Redlands, Riverside County, in addition to the Gavilan Hills near Riverside.

This extends the range considerably north of the original recorded point.

The species feeds on *Juniperus californica* Carr. and probably also on other native junipers. It was bred in captivity on Guadeloupe cypress.

a. *b.* *c.*

PLATE 21

Pupa of *Mitoura loki*, enlarged.
a. Ventral aspect. *b.* Lateral aspect. *c.* Dorsal aspect.

Erynnis tristis Bdv.

This species was unusually abundant in Southern California during the fall of 1931. Numerous eggs were secured in September, and a series were bred to maturity.

egg. Sub-spherical, with a flattened base. .8 mm. broad x .9 mm. high. Color, when first laid, a lemon-yellow, changing later

to a rich orange. There are from 18 to 20 longitudinal ribs extending from the base toward the micropyle, but many of these become confluent on the upper surface of the egg. These ridges are well defined and rise more sharply from the surface than is the case with other closely related species.

The grooves between these ridges are crossed transversely by numerous low inconspicuous ridges. At their point of juncture with the main ribs a slight, barely perceptible beading results.

Micropyle depressed. Emergence of the young larva occurs within 5 days from the time of oviposition.

The eggs are laid singly in the terminal tender leaves of *Quercus*. In the Los Angeles city parks, the cork oak seemed the species of choice, but eggs were found on several species of oaks.

Illustrated on Plate 22, fig. *a*.

LARVA: first instar. Length when newly emerged, 2.2 mm.

Head large in comparison with body; orange-yellow, with a number of short colorless vibrissae protruding from the lobes. Mouth parts, orange-yellow, the tips of mandibles and antennae brownish-black. Ocelli, black.

Body, uniform dirty yellow.

There are four rows of colorless, short hairs on each side placed longitudinally. Each separate hair arises from a papillus, the tip of which is black.

Under high magnification the surface of the body is seen to be studded with minute warts, concolorous with the body.

Legs and prolegs are of the same shade as the body surface. Duration of first instar, 5 days.

SECOND INSTAR. Length, 2.8 mm.

Head, black, or brownish-black, covered with short white spiculiferous hairs and bearing suggestions of orange spots on the cheeks. Body, dirty yellow, profusely studded with raised yellow nodules and bearing minute pile.

Legs and prolegs concolorous with body. The rows of hairs characteristic of the first instar have disappeared. Duration of instar, 5 days.

THIRD INSTAR.

Head brown, with a slightly more pronounced suggestion of the three orange spots near the edge on each lobe.

A barely perceptible narrow mid-dorsal line begins to appear and a prominent but narrow yellowish or dirty white lateral line is present. In other respects the larva is similar to the previously described instar.

FOURTH INSTAR.

Similar to last, but more pronounced orange spots on the cheeks and a slight increase in the definition of the mid-dorsal line. The duration of this and the final instar was not recorded.

a.

MATURE LARVA. Length, extended, 25. mm.

Head orange brown, with three large pale orange spots on each side. Covered with very short colorless pile. Bilobed, as shown in the illustration. A thin black collar occurs directly behind the head on the first segment.

Body, pale gray-green, covered with raised fungiform white dots, absent only on the first segment. Greatest girth at 5th and 6th segments. Mid dorsal line well defined, and caused by the absence of the raised papillae. A thin lemon lateral line extends from the 3rd segment to the caudal end.

Abdomen concolorous with body, but with fewer and more restricted white tubercles. The entire body is covered with short colorless pile, which, however, is absent on the first segment.

Legs concolorous with body, the tips colorless. Prolegs, same as legs, the claspers lighter in color. Stigmata white. Illustrated, Plate 22, fig. *b*.

When newly emerged the larva cuts two longitudinal incisions on the tip of a tender leaf and folds back the flap thus formed, uniting the edges to the leaf, thus making a protective nest. Later it makes a nest by uniting the edges of a single leaf, or it may bring two leaves together, uniting the edges. It remains concealed throughout life, except at the time of feeding. Pupation occurs within the protective domicile.

b.

PLATE 22

Egg and larva of *Erynnis tristis*.

a. Egg highly magnified.

b. Mature larva, enlarged.

PUPA. Length, 15 to 17 mm. Olive gray, the wing cases much darker. The segmental joints on the last four segments are a conspicuous pale olive-green.

Eye and prothoracic stigmata prominent and protruding.

The head, body and thoracic area covered with light brown vibrissae. A heavy tuft of longer sharp hairs over the eyes. Spiracles oval, not conspicuous.

There is a suggestion of a light supra-stigmatal longitudinal line.

Tongue case protruding only slightly beyond the wing cases. Venules slightly discernible through the chitinous covering of the wings. Illustrated, Plate 23.

Imagos emerged from January 24th to early May.

The larva were heavily parasitized with a small Ichneumonid, and in a few cases by a Tachinid, which may account for the scarcity of this insect.

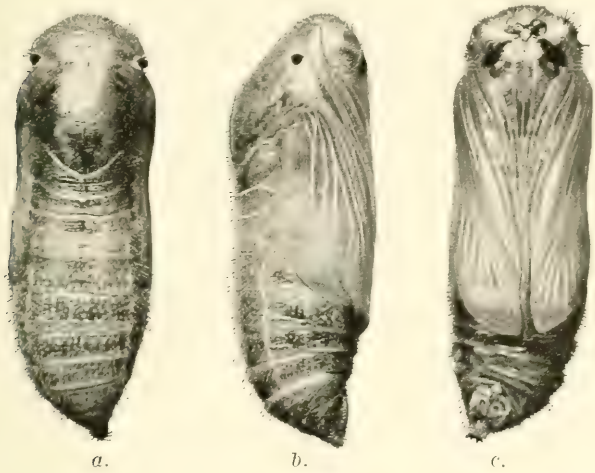


PLATE 23

Pupa of *Erynnis tristis*, enlarged.
a. Dorsal aspect. *b*. Lateral aspect. *c*. Ventral aspect.

NOTES ON THE FLORA OF THE CHANNEL ISLANDS OFF SANTA BARBARA, CALIFORNIA

Being chiefly a list of the species added to the flora of the islands since Brandegee's list in Zoe, Vol. 1, No. 5, July, 1890.

By Ralph Hoffmann

Director, Santa Barbara Museum of Natural History

The writer has since 1925 been collecting, for the herbarium of the Santa Barbara Museum of Natural History, on the four islands off Santa Barbara, viz.: Anacapa, Santa Cruz, Santa Rosa and San Miguel. About 420 additions have been made to Greene's and Brandegee's lists, 138 from Santa Cruz, 209 from Santa Rosa and 74 from San Miguel.

The writer plans eventually to publish a full list of the species found on the four islands, with notes on their distribution and habitat and on the relationship of the flora of each island to that of the others in the group and to that of the mainland.

The present paper is a list of the species added to the flora of the three islands covered by Brandegee's list, Santa Cruz, Santa Rosa and San Miguel, with brief notes on the distribution of each species. There are also notes on the status of certain species on which the writer's collections have thrown additional light. There has been no published list of the plants found on Anacapa Island since Yates' list of twenty-one species in the Ninth Annual Report of the State Mineralogist, of the California State Mining Bureau, 1890, p. 181. A few noteworthy species found on that island are, therefore, included in this paper.

In the Bulletin of the Southern California Academy of Sciences, Vol. XXX, Part 2, May-August, 1931, Mr. I. W. Clokey published a list of forty species collected by him on Santa Cruz Island, not given in Brandegee's list. Mr. Clokey gave no account of the distribution of the plants listed. The writer has, therefore, included in the following list most of the species in Clokey's list, with notes, based on his own observation, with regard to distribution, indicating in each case that the species occurs in Clokey's list.

The nomenclature used is that of Jepson's Manual of the Flowering Plants of California, wherever possible.

All species listed are represented by specimens in the herbarium of the Santa Barbara Museum of Natural History. Numbers used with the initials S. B. M. refer to this herbarium.

The preparation of the following list has been made possible by a generous gift, from Dr. Philip S. Chancellor, for field work on the islands.

The writer wishes to acknowledge with thanks the assistance which he has received from Dr. P. A. Munz in the preparation of the list. He also acknowledges gratefully the help which he

has received in determining difficult or doubtful species, from the following: LeRoy Abrams, C. R. Ball, S. F. Blake, Agnes Chase, Alice Eastwood, Carl Epling, Adele L. Grant, H. M. Hall, J. T. Howell, D. A. Johansen, I. M. Johnston, K. Mackenzie, A. Rehder, J. H. Schaffner, P. C. Standley, C. P. Smith, C. A. Weatherby and C. B. Wolf.

Mr. F. R. Fosberg, Mr. Guy Fleming and Mr. Benjamin Norris have deposited in the herbarium of the Santa Barbara Museum of Natural History specimens collected by them on the islands, and have given the writer permission to use their records.

Thanks are due to Mrs. Lora J. Knight for arranging two trips to the islands for collecting purposes.

Acknowledgment should be made of the courtesy extended to the writer, during his work on Santa Cruz, by Mr. Fred Caire and by the Santa Cruz Island Company, by Mr. N. R. Vail on Santa Rosa Island, and by Mr. R. L. Brooks on San Miguel Island.

GYMNOGRAMME TRIANGULARIS Kaulf. var. VISCOSA Eat.

Occasional on Santa Cruz* and Santa Rosa Islands, far less common than the type.

POLYPODIUM VULGARE L. var. KAULFUSSII (Eat.) Fer.

Exposed banks and sea cliffs, Santa Cruz* and Santa Rosa Islands.

POLYPODIUM SCOULERI H. & G.

Reported by Yates, (Bull. Santa Barbara Soc. Nat. Hist. 1:9, 1890) from Santa Cruz I.; questioned by Munz and Johnston (Am. Fern Journal, Vol. 12, no. 4, p. 118). Collected by the writer at the base of sea cliffs at Valdez Harbor and at East Twin Harbor, Santa Cruz I. S. B. M. No. 10,912, Nov. 10, 1930.

ADIANTUM CAPILLUS-VENERIS L.

At the head of a canyon, east of Tranquillon Canyon, on Santa Rosa I.

CHEILANTHES CALIFORNICA Mett.

Reported by Greene (Bull. Calif. Acad. of Sciences, II, 7, 1887) from Santa Cruz I. Dropped from the list for that island by Brandegee. Collected by the writer from the canyons back of Ladys, Dicks, Twin and Pelican Harbors on Santa Cruz I.*

PELLAEA ORNITHOPUS Hook.

Frequent on a rocky slope above Water Canyon and occasional on a canyon slope west of the Ranch, on Santa Rosa I.

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* (Clokey).

WOODWARDIA RADICANS Sm.

A few struggling plants on a steep side-wall of a canyon northwest of the Ranch, Santa Rosa I.

ATHYRIUM FILIX-FOEMINA (L.) Roth var. SITCHENSE Rupr. f. HILLII Butters (Gilbert).

Occasional along streams in the deep canyons on the north side of Santa Cruz I., (Pelican, Orizaba, Dicks and Ladys). S. B. M. No. 5156, Sept. 1, 1928. Determined by C. A. Weatherby.

POLYSTICHUM MUNITUM (Kaulf.) Presl.

One plant in Cañada de la Casa, Santa Rosa I.

CYSTOPTERIS FRAGILIS (L.) Bernh.

Damp ground at base of cliff, Orizaba Canyon, Santa Cruz I.

EQUISETUM FUNSTONI A. A. Eat.

Occasional along streams, both in the interior of Santa Cruz I. (Cañada de la Siesta) and on the north side (Punta Diablo, Hazards). S. B. M. No. 9156, April 7, 1930. Det. by J. H. Schaffner.

EQUISETUM KANSANUM Schaffn.

One station on a bank above the stream, one-half mile below the Main Ranch on Santa Cruz I. S. B. M. No. 9147, July 1, 1930. Det. by J. H. Schaffner.

EQUISETUM HYEMALE L. var. CALIFORNICUM Milde.

Abundant on a moist bank at the Water Hole, two miles west of China Harbor, Santa Cruz I. S. B. M. No. 11,154, Sept. 20, 1930. Det. by J. H. Schaffner.

SELAGINELLA BIGELOVII Underw.

Frequent on steep, rocky slopes and canyon banks on Santa Rosa I.

TYPHA sp.

Pool in Tranquillon Canyon, Santa Rosa I.; not in flower.

POTAMOGETON PECTINATUS L.

In the lagoon at Prisoners Harbor, Santa Cruz I.*

RUPPIA MARITIMA L.

In a brackish lagoon at the east end of Santa Rosa I.

ZOSTERA MARINA L.

Off Santa Rosa I.

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* (Clokey).

PHYLLOSPADIX TORREYI Wats.

Common on submerged rocks, off San Miguel I.

BROMUS CARINATUS H. & A.

Occasional on open banks, San Miguel I.

BROMUS HORDACEUS L.

Common and widely distributed on Santa Cruz I.*; common in the interior and to the south on Santa Rosa I.

BROMUS LAEVIPES Shear.

Occasional on wooded slopes on Santa Cruz and Santa Rosa Is. S. B. M. No. 10,132, June 29, 1930, and No. 10,180, June 13, 1930. Det. by Mrs. Agnes Chase.

BROMUS MARITIMUS (Piper) Hitchc.

Anacapa I.; frequent on sea cliffs, San Miguel I. S. B. M. No. 4136, March 11, 1928, and No. 11,952, Apr. 19, 1932. Det. by Mrs. Chase.

BROMUS MARGINATUS Nees.

Frequent on sea cliffs, Santa Cruz, Santa Rosa and San Miguel Is.

BROMUS RIGIDUS Roth.

One collection on Santa Rosa I. S. B. M. No. 7648, April 20, 1929. Det. by Mrs. Chase.

BROMUS RIGIDUS var. GUSSONEI (Parl.) Coss. & Dur.

Abundant on Santa Cruz, Santa Rosa and San Miguel Is.

BROMUS RUBENS L.

Widely distributed on open, even on rocky slopes, on Santa Cruz I.; common in the interior and toward the south shore of Santa Rosa I.

BROMUS SUBVELUTINUS Spear.

Occasional on wooded slopes, Santa Rosa I. S. B. M. No. 7649, April 18, 1929. Det. by Mrs. Chase.

BROMUS TRINII Desv.

On a steep canyon bank, Santa Rosa I., and on a rocky headland, San Miguel I.

FESTUCA BROMOIDES L.

Common and widely distributed on Santa Cruz* and Santa Rosa Is.; occasional on San Miguel I.

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* (Clokey).

Festuca megalura L.

Common and widely distributed on Santa Cruz* and Santa Rosa Is.; occasional on San Miguel I.

Festuca octoflora Walt.

Occasional on bare, rocky slopes on Santa Rosa and San Miguel Is.

Festuca pacifica Piper.

One collection on a rocky slope, near Pelican Harbor, Santa Cruz I., and one on San Miguel I. S. B. M. No. 11,953, April 22, 1932 and No. 4991, June 11, 1930. Det. by Mrs. Chase.

Poa annua L.

Frequent in moist ground on Santa Rosa and San Miguel Is.

Poa douglasii Gray.

Frequent on sandy slopes, near the sea, on Santa Rosa I.; occasional on San Miguel I. S. B. M. No. 9152, April 8, 1930, and No. 9494, April 11, 1930.

Poa scabrella Thurb.

Frequent on shaded banks, Santa Rosa I. S. B. M. No. 945, March 26, 1927.

Lamarckia aurea Moench.

Frequent on rocky slopes, Santa Cruz I., occasional on Santa Rosa I. and one collection on Prince I., off San Miguel I.

Melica imperfecta Trin.

Common on steep banks on Santa Rosa I. and occasional on canyon banks and sea cliffs on San Miguel I.

Melica imperfecta var. flexuosa Boland.

Occasional on shaded banks, Santa Cruz I. S. B. M. No. 499, March 28, 1925. Det. by Mrs. Chase.

Elymus condensatus Presl.

Frequent on canyon banks on Santa Rosa I.

Elymus glaucus Buckl.

Occasional on wooded banks and canyon walls on Santa Cruz and Santa Rosa Is.

Elymus triticoides Buckl.

In waste ground at the Main Ranch on Santa Cruz I.; common on wind swept mesas on Santa Rosa and San Miguel Is.

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* (Clokey).

Hordeum gussoneanum Parl.

Occasional on Santa Rosa I. S. B. M. No. 12,109, May 10, 1932. Det. by Mrs. Chase.

Hordeum murinum L.

Common on San Miguel I.

Hordeum nodosum L.

Occasional on exposed hills and mesas on Santa Cruz I.; frequent on Santa Rosa and San Miguel Is.

Hordeum pusillum Nutt.

Occasional in low ground, San Miguel I.

Lolium perenne L.

In waste ground, Main Ranch, Santa Cruz I.

Lolium temulentum L.

Occasional in waste ground and fields near ranches, Santa Cruz and Santa Rosa Is.

Lolium temulentum var. arvense Bab.

One collection on Santa Cruz I.

Pholiurus incurvus (L.) Schinz & Thell.

On the border of a stream near the sea and in a salt lagoon on Santa Rosa I.

Avena barbata Brot.

Common and widely distributed on Santa Cruz* and Santa Rosa Is.

Avena fatua L.

Frequent on Santa Rosa I.

Agrostis diegoensis Vasey.

Frequent on shaded banks on Santa Cruz and Santa Rosa Is. S. B. M. No. 4751, June 15, 1930, and No. 4789, June 13, 1930. Det. by Mrs. Chase.

Agrostis exarata Trin.

Frequent on canyon banks, on Santa Cruz and Santa Rosa Is.; the form *A. microphylla* Steud. occurs on Santa Rosa I. S. B. M. No. 10,765, Aug. 7, 1930. Det. by Mrs. Chase.

Agrostis verticillata Vill.

Common in stream beds and on moist banks, Santa Cruz I.

* (Clokey).

Polypogon lutosus (Poir.) Hitchc.

Occasional on the borders of streams or in seepage from cliffs on Santa Cruz, Santa Rosa and San Miguel Is.

Gastridium ventricosum (Gouan) Schinz & Thell.

Common on rocky slopes near Pelican Harbor, Santa Cruz I.*; collected on a rocky slope in the interior of Santa Rosa I.

Muhlenbergia microsperma (DC.) Kunth.

Frequent on steep rocky slopes with southern exposure, Santa Rosa I.

Oryzopsis miliacea (L.) B. & H.

A patch has persisted for many years near the Ranch House on Santa Rosa I. but has not spread.

Stipa lepida Hitchc.

Common on rocky slopes, Santa Rosa I.

Stipa pulchra Hitchc.

A few plants on a rocky mesa near the east end of San Miguel I.

Aristida adscencionis L.

Occasional on steep, rocky slopes with southern exposure on Santa Cruz I. S. B. M. No. 6633, March 22, 1929.

Cynodon dactylon (L.) Pers.

Occasional near dwellings and ranches, Santa Cruz and Santa Rosa Is.

Phalaris bulbosa L.

In waste ground at the Main Ranch, Santa Cruz I. S. B. M. No. 7556, June 15, 1930. Det. by Mrs. Chase.

Phalaris lemmonii Vasey.

On an open mesa, northwest of the Ranch, on Santa Rosa I. S. B. M. No. 12,072, May 10, 1932.

Phalaris minor Retz.

Occasional near the sea on Santa Rosa and San Miguel Is.

Eleocharis palustris R. & S.

In a stream bed, in the Cañada del Rancho Viejo, Santa Rosa I.

Scirpus californicus Britt.

A large colony in the lagoon at Prisoners Harbor, Santa Cruz I.

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* (Clokey).

SCIRPUS CERNUUS Vahl.

On a wet bank, at the mouth of Arlington Canyon, Santa Rosa I.

SCIRPUS OLNEYI Gray.

On a wet bank, at the mouth of Arlington Canyon, Santa Rosa I.

CAREX BARBARAE Dewey.

On the border of the stream, one-half mile below the Main Ranch, Santa Cruz I. S. B. M. No. 11,131, Apr. 12, 1931.

CAREX GLOBOSA Boott.

Frequent on rocky brushy slopes, on Santa Rosa I.

CAREX GRACILIOR Mkze.

On a ledge above the stream at Scorpion Harbor, Santa Cruz I.; on the border of the stream, Cañada de la Casa, Santa Rosa I. S. B. M. No. 5568, March 17, 1929, and No. 12,112, May 10, 1932. The former determined by K. Mackenzie.

CAREX MONTEREYENSIS Mkze.

On the moist face of a cliff, Pelican Harbor, Santa Cruz I. S. B. M. No. 11,125, Sept. 10, 1931. Det. by K. Mackenzie.

CAREX PANSA Bailey.

Occasional on sandy slopes, near the sea, Santa Rosa I. S. B. M. No. 12,304. Det. by K. Mackenzie.

CAREX PRAEGRACILIS Boott.

One collection on Santa Cruz I., near the ridge above China Harbor, and one on a sandy slope, on the east end of Santa Rosa I. S. B. M. No. 11,129, April 18, 1931, and No. 12,111.

CAREX SENTA Boott.

Along the stream at Dicks Harbor, and in the Cañada de la Siesta, Santa Cruz I. S. B. M. No. 11,836, March 25, 1932.

CAREX TRIQUETRA Boott.

One collection on Santa Cruz I. S. B. M. No. 238, March 28, 1925.

JUNCUS BUFONIUS L.

Frequent in moist ground on San Miguel I.

JUNCUS XIPHIOIDES E. Mey.

Along the bed of a short canyon, northwest of the Ranch, Santa Rosa I. S. B. M. No. 12,161, May 5, 1932.

LUZULA CAMPESTRIS DC. var. CONGESTA Buch.

The variety is commoner than the type, both on Santa Cruz and Santa Rosa Is.

Chlorogalum pomeridianum (Ker.) Kunth.

Occasional on a grassy hill top on Santa Rosa I.

Allium hyalinum Curr. var. praecox Jepson.

Frequent on grassy mesas near the sea and on slopes above canyons on Santa Rosa I.

Brodiaea synandra (Hel.) Jepson.

Frequent on canyon banks and mesas near the sea on the north-east end of Santa Rosa I.

Calochortus catalinae Watš.

Occasional on brushy slopes on Santa Rosa I.

Calochortus luteus Dougl.

Locally common on grassy slopes near the Main Ranch on Santa Cruz I.

Habenaria michaeli Greene.

Frequent on rocky slopes, Santa Rosa I. S. B. M. No. 10,408, June 13, 1930.

Epipactis gigantea Dougl.

Occasional on moist banks of Santa Cruz I. (five localities).

Salix lasiandra Benth.

At Valdez Harbor, Santa Cruz I. S. B. M. No. 10,800, Nov. 9, 1930. Det. by C. R. Ball.

Salix lasiolepis Benth.

Common and widely distributed along streams on Santa Rosa I.

Quercus chrysolepis Liebm.

Greene's statement that this species occurs on the "north side, near summit" of Santa Cruz I., is confirmed by collections from the high ridge at the head of Twin Harbor Canyon (a grove of about a dozen trees) and from just north of the summit of Mt. Diablo (about fifteen trees). S. B. M. No. 11,188, Sept. 8, 1931.

Quercus lobata Neé.

Brandegee records finding "small" *Quercus lobata* on Santa Cruz I. There are two trees in the Cañada del Medio about a mile and a half west of the Main Ranch which, except for the bark, match *Q. lobata* of the mainland. One of these has a circumference of twenty-nine feet, three feet above the ground, with a spread of fifty-four feet. The question of their specific identity is still unsettled in the writer's mind. See under *Q. macdonaldi*.

QUERCUS MACDONALDI Greene.

Jepson makes this tree a subspecies of *Q. dumosa;* Trelease (Flora of Santa Catalina I., p. 77) describes it as a "Small evergreen tree." On Santa Cruz I. the tree is deciduous. If it is not a distinct species, it seems to the writer to be much more closely related to *Q. lobata* than to *Q. dumosa.*

QUERCUS MOREHUS Kell.

A single tree in a canyon west of Portezuelo, on Santa Cruz I. S. B. M. No. 11,142, April 12, 1931.

QUERCUS TOMENTELLA Engelm.

In the only deep canyon on Anacapa I.

URTICA URENS L.

Occasional on Santa Rosa I.

HESPEROCNIDE TENELLA Torr.

Occasional on shaded banks on Santa Cruz I.

ANEMOPSIS CALIFORNICA (Nutt.) Hook.

A small colony at the border of the lagoon at Prisoners Harbor, Santa Cruz I.*

This plant, Yerba Manza, though in plain sight at Prisoners Harbor, where Greene must have landed in 1886, is not on his list. The writer's conjecture that it might have been brought over from the mainland by an employee of Mr. Caire and planted where it could be easily gathered for medicinal purposes, was confirmed by Michael Lugo, who was told by one Francisco Leyva that he (Leyva) had planted it at Prisoners.

POLYGONUM AVICULARE L. var. LITTORALE Koch.

Near the beach at Scorpion Harbor, Santa Cruz I. S. B. M. No. 10,306.

POLYGONUM RAMOSISSIMUM Michx.

Occasional near ranches, Santa Cruz I.

RUMEX ACETOSELLA L.

A small colony on a grassy bank, toward the west end of Santa Cruz I.

RUMEX CRISPUS L.

Common along streams on Santa Rosa I., and occasional on moist banks on San Miguel I.

PTEROSTEGIA DRYMARIOIDES F. & M.

Frequent on north slopes and on sea cliffs on San Miguel I.

* (Clokey).

LASTARRIAEA CHILENSIS Remy.

A large colony at the mouth of Corral Canyon on the south shore of Santa Cruz I., locally common on a sandy area on the east end of Santa Rosa I. and occasional as far north as Water Canyon on Santa Rosa I.

CHORIZANTHE INSULARIS sp. nov.

Chorizanthe staticoides Benth. is given from Santa Cruz and Santa Rosa Is. in Brandegee's list. Examination of a large amount of material collected on both islands shows several marked differences between the island plant and *C. staticoides.* The writer has therefore given the island plant specific rank under the above name. He wishes to express his appreciation of Miss Eastwood's courtesy in giving him her MS. notes, made when she had also decided that the island plant was specifically distinct.

Plant generally low, 2-8 (14) cm., erect, simple or in vigorous plants with wide-spreading and somewhat flexuous branches, dichotomously branching, generally from 1-2 cm. above the base, villous; leaves ovate-oblong, 1-3½ cm. long, 4-6 mm. wide, narrowing at base to slender petioles, longer than the blades, rounded at tip, often reddish above though villous, white-tomentose below; leaves basal and in whorls at the nodes, passing into foliaceous, lanceolate, mucronate bracts; involucres 2 mm. long, very numerous, *crowded at the ends of the branching inflorescence, forming runded heads,* or solitary at the nodes and 4 mm. long, sparsely pubescent; the teeth short, the alternate ones smaller: *flowers white,* 2½ mm. broad; calyx lobes oblong-ovate; stamens 6.

Type specimen No. 254, Ralph Hoffmann, Herbarium of Santa Barbara Museum. No. 12,302.

Planta plerumque humilis, 2-8 (14) cm. alta, erecta, simplex aut, in plantis robustis, cum ramis late expansis et aliquanto flexuosis, dichotome divisa, plerumque a 1-2 cm. supra basem, villosa; foliis ovato-oblongis, 1-3.5 cm. longis, 4-6 mm. latis, basi angustatis in petiola tenuia, longiora quam laminae, apice rotundatis, supra saepe subrubris, villosis autem, subtus albo-tomentosis; foliis a basi et in verticillis ad nodos, superioribus conversis in bracteas foliaceas, lanceolatas, mucronatas; involucris 2 mm. longis, numerosissimis, *ad fines inflorescentiae ramosae congestis, capitula rotundata facientibus,* aut solis ad nodos et 4 mm. longis, sparse pubescentibus; dentibus brevibus, alternis minoribus; *floribus albis,* 2.5 mm. latis; lobis calycis oblongo-ovatis; staminibus 6.

Chorizanthe insularis has hitherto passed as *C. staticoides* Benth. in Greene's and Brandegee's lists (Greene, Bull. Calif. Acad. of Sciences II, 7, 1887; Brandegee, Zoe, I, 5, 1890). It differs from *C. staticoides,* as described by Watson (Geological Survey of Calif. Botany, II, p. 37), in the presence of foliaceous bracts, and in this respect seems closer to *C. Xanti* Watson, from which it differs in the crowding of its numerous small involucres

into subcapitate cymes. It differs from both species in its conspicuous white flowers.

It occurs on Santa Cruz I. on nearly every rocky slope with southern exposure, from the north side to the south side of the island; it is less common on Santa Rosa I. It is well-developed by the middle of February, but does not yet show the inflorescence. Early in April it begins to flower, and by the end of June it has for the most part passed flowering.

ERIOGONUM GIGANTEUM Wats.

Jepson (Manual of the Flowering Plants of California, p. 313) gives Santa Cruz as within the range of this species. The writer has never found it on the island nor seen any specimens collected there.

ERIGONUM NUDUM Dougl. var. GRANDE Jepson.

Jepson includes in this variety *Eriogonum grande* Greene and *E. rubescens* Greene. A large series from all the islands under discussion seems to show that the material can not all be included in one variety. On Anacapa I. the plant never has red flowers, grows to a height of 70 cm., and in its compact panicles often approaches *E. latifolium* Sm.* On Santa Rosa and San Miguel Is. and on the west end of Santa Cruz I., the plant always has red flowers, and on sea cliffs or on mesas above the sea, in the same situations as on Anacapa, it often grows less than 20 cm. high, but again with a very compact panicle.

APHANISMA BLITOIDES Nutt.

Frequent on mesas above the sea, on the west end of Santa Cruz I. and on the south side of Santa Rosa I.

CHENOPODIUM CALIFORNICUM Wats.

Frequent on grassy or rocky slopes on Santa Rosa I.

CHENOPODIUM MURALE L.

Frequent and widely distributed on Santa Rosa I.

MONOLEPIS NUTTALLIANA (R. & S.) Wats.

Occasional in low ground near the sea on Santa Cruz I.; frequent on bare ridges toward the south shore of Santa Rosa I; occasional on San Miguel I.

ARTIPLEX BRACTEOSA Wats.

In waste ground at Pelican Harbor on Santa Cruz I. S. B. M. No. 2132, June 14, 1930. Det. by H. M. Hall.

* Yates (9th Ann. Rep. State Min. 1890, p. 187) recorded *E. latifolium* from Anacapa I.

A. BRACTEOSA Wats. (minor variation 1 of Hall and Clements). (A. DAVIDSONI Standl.).

Occasional on mesas along the south shore of Santa Rosa I. S. B. M. No. 12,305. Det. by H. M. Hall.

A. COULTERI (Moq.) Dietr.

Frequent on mesas above the sea at the west end of Santa Cruz I., and on bare slopes from the interior to the south shore of Santa Rosa I.; occasional on San Miguel I.

A. EXPANSA (D. & H.) Wats. (A. ARGENTEA Nutt. subsp. EXPANSA (Wats.) Hall & Clements).

A colony near the beach at Smugglers Cove, on Santa Cruz I., and one on the beach at Arlington Canyon on Santa Rosa I.

A. MICROCARPA (Benth.) Dietr.

On mesa above cliffs, Anacapa I. S. B. M. No. 4122. Det. by H. M. Hall.

A. PATULA L. subsp. HASTATA (L.) Hall and Clements.

Occasional on the north side of San Miguel I., under cliffs with seepage.

A. LEUCOPHYLLA Dietr.

Common on beaches on Santa Rosa I.

A. SEMIBACCATA R. Br.

Widely distributed on open slopes and mesas, especially near the sea, on Santa Cruz and Santa Rosa Is.; occasional on San Miguel I.

AMARANTUS BLITOIDES Wats.

In waste ground near a dwelling at Cochies Prietos on Santa Cruz I., and in cultivated ground near the Ranch on Santa Rosa I.

A. GRAECIZANS L.

In cultivated ground near the Ranch on Santa Rosa I.

ABRONIA ALBA Eastw.

On sand dunes at the north-east end of Santa Rosa I. and on San Miguel I. S. B. M. No. 9772, April 8, 1930, and No. 5726, June 11, 1930. Det. by P. C. Standley.

A. ALBA var. VARIABILIS Jepson. (A. MINOR Standl.)

On the beach at the mouth of Corral Canyon, on the south shore of Santa Cruz I., and on the north-east end of Santa Rosa I. S. B. M. No. 1214, June 30, 1930, and No. 10,073, Aug. 7, 1930. Det. by P. C. Standley.

A. ALBA var. PLATYPHYLLA Jepson.

On sandy slopes at the north-east end of Santa Rosa I. S. B. M. No. 9363, Apr. 8, 1930. Det. by P. C. Standley.

A. LATIFOLIA Esch.

A single plant was found by B. Norris on the beach on the north shore of San Miguel I. S. B. M. No. 8809, Apr. 11, 1930. Det. by P. C. Standley.

A. MARITIMA Nutt.

Common on beaches and sandy slopes above the sea on Santa Rosa I.

MIRABILIS LAEVIS (Benth.) Curr.

Occasional on the south-east end of Santa Rosa I.

TETRAGONIA EXPANSA Murr.

Occasional on beaches on Santa Rosa and San Miguel Is.

MESEMBRYANTHEMUM AEQUILATERALE Haw.

Occasional on sea cliffs at the west end of Santa Rosa I.

M. NODIFLORUM L.

Occasional on Santa Rosa and San Miguel Is.

CALANDRINIA BREWERI Wats.

Occasional on rocky slopes on Santa Rosa I. S. B. M. No. 10,923, Apr. 18, 1932.

CALANDRINIA CAULESCENS H. B. K.

Common on grassy slopes and on rocky summits on Santa Rosa I.; occasional on San Miguel I.

C. CAULESCENS var. MENZIESII Gray.

Frequent on Santa Rosa I., in richer soil than the type.

CALANDRINIA MARITIMA Nutt.

Occasional on rocky slopes near the sea, Santa Rosa I.

MONTIA FONTANA L.

On borders of streams on Santa Cruz I., near Twin Harbor and east of Orizaba Harbor. S. B. M. No. 11,872, Feb. 27, 1932.

MONTIA PERFOLIATA (Donn.) Howell.

Frequent on steep north slopes on San Miguel I.

M. PERFOLIATA var. PARVIFLORA Jepson.

Frequent in poor soil on Santa Cruz I.

Portulaca oleracea L.

A garden weed at the Main Ranch on Santa Cruz I.

Cerastium viscosum L.

Frequent on grassy borders of streams on Santa Cruz I.; occasional on Santa Rosa and San Miguel Is.

Stellaria media (L.) Cyr.

Frequent on north slopes on San Miguel I.

Stellaria nitens Nutt.

Occasional on shaded banks on Santa Rosa I.

Sagina occidentalis Wats.

Occasional on San Miguel I.

Arenaria douglasii Fenzl.

Occasional on rocky slopes on Santa Rosa I.

Spergularia salina J. & C. Presl.

Occasional on flats back of beaches on Santa Cruz I. (Prisoners Harbor, Dicks Harbor).

Spergula arvensis L.

Collected by Leroy Abrams on Santa Cruz I.; locally common south-east of the Ranch on Santa Rosa I.

Polycarpum depressum Nutt.

A single plant in a stony wash at Willows, on the south shore of Santa Cruz I. S. B. M. No. 5117, June 30, 1930.

Pentacaena ramosissima H. & A.

Occasional on San Miguel I.

Silene antirrhina L.

Occasional on rocky slopes on Santa Rosa I.

(To be continued)

The recent tragic death of Mr. Ralph Hoffmann will not, as was first feared, interrupt the publication of this important paper. The officials of the Santa Barbara Museum of Natural History have assured us that Mr. Hoffmann's notes are in such shape as to insure its continuance.—Ed.

SOUTHERN CALIFORNIA PLANT NOTES—IV*

PHILIP A. MUNZ

Unless otherwise indicated all specimens cited in this paper are in the Herbarium of Pomona College, Claremont, California.

Delphinium Parryi Gray var. **montanum** Munz, n. var.

Caules et folia glabra. Type, Vincent Gulch, San Gabriel Mts., at 6600 ft., *Munz* 6846, Pomona College Herbarium No. 18068. Ranging at 5000 to 7500 ft. in the San Gabriel and San Bernardino Mts. and at Mt. Pinos. In its smoothness this plant resembles *D. decorum* F. & M., but the leaf-divisions are narrower and the seeds are sharply angled as in *D. Parryi*.

Delphinium Parryi Gray var. **subglobosum** (Wiggins) Munz, n. comb.

Delphinium subglobosum Wiggins, Contr. Dudley Herb. Stanford Univ. 1:99. pl. 7. 1929.

Stems glabrous, glaucous; leaves long-pubescent; follicles 6-11 mm. long. Eastern San Diego Co. (Banner, San Felipe, Montezuma Valley, Campbells). Differing from *D. Parryi* which has pubescent stems and follicles 10-15 mm. long, but intergrading with it.

Delphinium Parishii Gray var. **pallidum** Munz, n. var.

Flores pallidi, fere albidi; sepalis 6-7 mm. longis. Type, from Seymour Creek, Mt. Pinos, at 5900 ft., June 10, 1923, *Munz* 6954, Pomona College Herbarium No. 20509. I have seen other collections from Mt. Pinos and one from Holcomb Valley in the San Bernardino Mts., *Munz* 10659. The plants here included have been variously treated and bear a superficial resemblance to *D. cuyamacae* Abrams of San Diego Co., but differ from that species by their pubescent follicles. They differ from *D. Parryi* and agree with *D. Parishii* in the possession of a loose cellular coat about the seeds. In *D. Parishii* of lower altitudes the flowers are more definitely blue and the sepals are 8-10 mm. long.

Sisymbrium diffusum Gray var. **Jaegeri** Munz, n. var.

Perennis, diffusa, cinereo-tomentosa, 3-5 dm. alta; caulibus foliosis; foliis inferioribus 5-8 cm. longis, cinereis, profunde sinuato-dentatis vel lobatis, cum petiolis brevibus et alatis; foliis superioribus reductis, sessilibus; racemis 5-10 cm. longis; pedicellis porrectis, 4-7 mm. longis, sepalis 2.5-3.5 mm. longis; petalis albis, 3.5-4 mm. longis; capsulis lente porrectis, pubescentibus, 1.5-2 cm. longis, vix 1 mm. crassis, subtorulosis, cum rostro tenue 1.5-2 mm. longo; seminibus circa 0.6 mm. longis.

Type from Westgaard Pass, Inyo Co., *M. E. Jones in July*, 1928, Pomona College Herbarium No. 173484. I have seen also material from Clark Mts. in the eastern Mohave Desert, collected by *Jaeger*, and from Coso Mts., *Coville & Funston* (Gray Herbarium at Harvard). It is a pleasure to name this variety for Mr. E. C. Jaeger whose many years of collecting on the deserts of California have produced such interesting results. The variety differs from typical *S. diffusum* of southern Arizona, New Mexico and Texas by having the leaves more sharply dentate, the sepals 2.5-3.5 mm. long instead of 2 mm. long, and the petals 3.5-4 mm. long instead of 2-3 mm.

*The third paper of this series appeared in the Bull. So. Calif. Acad. 24:47-51. 1925.

Cardamine oligosperma Nutt., T. & G., Fl. N. Am. 1:85. 1838.

This annual crucifer, hitherto known from Monterey Co. northward, and from Topango Canyon, *Hasse*, has recently been collected in San Dimas Canyon, San Gabriel Mts., *Louis C. Wheeler* 506.

Lesquerella bernardina Munz, n. sp.

Perennis, omnino argenteo-stellata; caulibus compluribus, ascendentibus, 1-2 dm. altis; laminis foliorum infimorum ovatis aut oblongis, 5-20 mm. longis, integris, obtusis, in petiola longiora subito angustatis; foliis caulium anguste oblanceolatis, 4-12 mm. longis, cum petiolis brevibus; sepalis stellato-puberulentis, 6 mm. longis; petalis aureis, spatulatis, 9-10 mm. longis; pedicellis fructiferis 8-11 mm. longis, ascendentibus vel porrectis et sigmoideis; capsulis subglobosis, 5 mm. crassis, stellato-pubescentibus; stylis 6-9 mm. longis; seminibus 2 in cella utraque, brunneis, compressis, 2-2.5 mm. crassis, non alatis.

Type, from rocky ground under pines, north side of Bear Lake, at the east end of Bear Valley, San Bernardino Mts., *Peirson* 4600, May 16, 1924, Pomona College Herbarium 49820. Other collections from the same region have been made: *Jones in* 1900 and *Johnson in* 1924. The proposed species is nearest to *L. Kingii* Wats. of the Panamint and Providence Mts. and adjacent Nevada and has passed as that species, but *L. Kingii* has petals 6-7 mm. long and style 3-5 mm. long.

Thysanocarpus laciniatus Nutt., ex T. & G., Fl. N. Am. 1:118. 1838.

In the typical form of the species the capsules are glabrous, reticulate, broadly elliptic to orbicular, ca. 3 mm. wide including the broad, subentire, greenish or purplish wing which lacks well defined rays. In Southern California it is common on grassy slopes, in washes, etc. below 3500 ft. in the coastal drainage, and is occasional on the Mohave Desert in a green-winged form with broad leaves (Granite Well, Shepherd Canyon, etc.). There is free intergradation with the following varieties:

Var. crenatus (Nutt.) Brew. (Bot. Calif. 1:49. 1876). Wing rayed and notched or perforate between the rays. Growing with the species.

Var. ramosus (Greene) Munz, n. comb. (*T. ramosus* Greene, Bull. Calif. Acad. 2:390. 1887). Capsule larger, 4 mm. or more wide, including the wings. Santa Rosa, Santa Cruz, and San Clemente Islands.

Var. affinis (Greene) Munz, n. comb. (*T. affinis* Greene, Pittonia 4:311. 1901). Capsule 3-3.5 mm. wide, pubescent. Catalina Island and adjacent mainland, to Claremont, Santa Ana Canyon, and Santa Barbara.

Var. Hitchcockii Munz, n. var. Capsula conferta, luteo-virida, 2.5-3 mm. lata, scabrella, cum capillis parvis clavatisque. Type, from Dante's Point, Death Valley, *P. A. Munz & C. L. Hitchcock* 11016, April 6, 1928, Pomona College Herbarium No. 145825. Well distributed on the western Mohave Desert, as at Cushenberry, Hesperia, Willow Springs, Mohave, etc.

Var. rigidus Munz, n. var. Plantae rigidae, compactae, 3-12 cm. altae, subpurpureae; foliis pinnatifidis; pedicellis porrectis, non recurvatis; capsulis glabris, 2.5 mm. latis, subcrenatis. Type, Laguna Camp, Laguna Mts., San Diego Co., May 16, 1925, *Munz* 9701, Pomona College Herbarium No. 82645. Another collection is from 50 miles southeast of Tecate, Lower California, *Munz* 9572.

Arabis Shockleyi Munz, n. sp.

Perennis, cum caudice crasso simpliceque; caule non ramoso, 1-2 dm. alto, stellato-canescente; foliis albidis, stellato-canescentibus; foliis infimis confertis, oblanceolatis vel spatulatis, laminis 1-1.5 cm. longis, 3-5 mm. latis, subintegris, obtusis, in petiola alata et 5-10 mm. longa, angustatis; foliis caulium lanceolato-ovatis, sessilibus; amplectentibus,

acuminatis, 1-2 cm. longis; floribus confertis, 15-25; pedicellis fortibus, stellato-canescentibus, ascendentibus aut subporrectis, 8-10 mm. longis; calyce laxe stellato, ca. 5 mm. longo, subroseo; corolla subrosea, 1 cm. longa; petalis vix 1 mm. latis, oblanceolato-linearis, erectis; capsulis ascendentibus vel porrectis, subarcuatis, glabris, 5-7 cm. longis, 1.5-2 mm. latis, sine stylis persistentibus; seminibus in 2 ordinibus et 1 mm. longis.

Type, Mellin Mt., near Candelaria, Nevada, *Shockley* 366, May 1884 (Gray Herbarium). Another collection is from a dry canyon on the north slope of the San Bernardino Mts., May 1882, *S. B. & W. F. Parish* 1302 (Gray). Referred to *A. Beckwithii* Wats. by Robinson (Syn. Fl. N. Am. vol. 1, pt. 1:165. 1895), but differing from that species in the more canescent and broader leaves and narrower petals, the type of *Beckwithii* at Gray having petals 14 mm. long with the claw 3-4 mm. wide and cauline leaves very crowded, greenish and about 4 cm. long. Except for the spreading pods, the proposed species superficially resembles *A. subsinuata* Wats.

Arabis dispar Jones, Contr. Western Bot. 8:41. 1898.

A. nardina Greene, Leaflets Bot. Obs. 2:70. 1910.

This species seems to have been overlooked to a considerable extent. It is a caespitose perennial, stellate-canescent, with basal leaves tufted, 1 cm. long, 2-3 mm. wide; stems 1-2 dm. tall; petals pinkish, 5-6 mm. long; fruiting pedicels ascending, 3-10 mm. long; capsules erect or ascending, 4-7 cm. long, 3-4 mm. wide, scarcely if at all beaked with a persistent style; seeds nearly in 1 row, broadly margined.

I have seen material from Panamint Mts., *Jones in* 1897, *Munz in* 1932; from Cactus Flat above Cushenberry Canyon, *Jones in* 1926; and from Quail Springs in the Little San Bernardino Mts., *Munz & Johnston* 5214.

Arabis Johnstonii Munz, n. sp.

Perennis, caespitosa, stellato-canescens; caulibus ascendentibus, 1-2 dm. longis; foliis infimis spatulatis, circa 1 cm. longis, subintegris, cum petiolis longioribus; foliis caulium oblongo-lanceolatis, subsessilibus, 8-15 mm. longis, 2-3 mm. latis; pedicellis ascendentibus, 6-8 mm. longis; petalis roseis, 8-10 mm. longis, 1.5 mm. latis; calycibus 4-5 mm. longis; capsulis 3-5 cm. longis, 2-2.5 mm. latis; stylis persistentibus, filiformibus, 1-2 mm. longis; seminibus 1.5 mm. latis, alatis.

Type from Kenworthy, San Jacinto Mts. at 4500 ft., *Munz & Johnston* 5485, May 19, 1922, Pomona College Herbarium No. 13275. Very much like *A. dispar* Jones, but with larger flowers and definite persistent styles.

Arabis maxima Greene var. **Hoffmannii** Munz, n. var.

Folia viridia, dorsale glabra; petalis albis, 1 cm. longis. Type, from sea-cliff east of Dicks Harbor, Santa Cruz Island, *Hoffmann* 653, Pomona College Herbarium No. 179251; isotype at Santa Barbara Museum. Mr. Hoffmann has one or two additional collections from Santa Cruz I. in the Santa Barbara Museum of Natural History. This plant differs strikingly from *A. maxima* Greene of the mainland in which the leaves are grayish, stellate-pubescent, and the petals are rose, 8-10 mm. long. It is necessary to take up Greene's name for our common cismontane plant of low altitudes instead of *A. arcuata* (Nutt.) Gray, (Proc. Am. Acad. 6:187. 1864) as the name *arcuata* had been used earlier (Shuttlw., ex Godet, Fl. Jura 1:38. 1852). It is characterized by its arcuate spreading capsules which are 5-8 cm. long, by its coarse tall stems (5-8 dm.), and by the basal leaf-blades being 3-5 cm. long.

Echeveria lagunensis Munz, n. sp.

Perennis, glauca; caulibus floriferendis fortibus, 2-5 dm. altis, glaucis, subrubris; foliis inferioribus obovatis aut spatulatis, acutis aut acuminatis, 5-15 cm. longis, 3-5 cm. latis, glaucis; foliis caulium amplectentibus, 8-30 mm. longis, 6-20 mm. latis, subrubris, glaucis; paniculis 5-12 cm. latis; pedicellis fortibus, glaucis, 5-15 mm. longis; calycibus glaucis, 5-7 mm. longis, lobis lanceolatis et 3-5 mm. longis; corollis 12-14 mm. longis, subrutilis, lobis 4.5-6 mm. longis, subglaucis.

Type from dry stony slopes, Campbell Ranch, Vallecito Valley, eastern San Diego County, *Munz and Hitchcock* 12612, April 3, 1932, Pomona College Herbarium No. 179249. Another collection is from Vallecito Canyon, Laguna Mts., *Munz* 9864. This species is common between 2000 and 4000 ft. on the desert slopes of the Laguna and Cuyamaca Mts. It is closely related to the more coastal *E. pulverulenta* Nutt. in its glaucous condition, broad leaves in the basal rosette and rather large suborbicular leaves of the stems. But the color of the flowers is brick-red instead of deep red, and the plant as a whole is glaucous rather than pulverulent. It seems to differ from *Dudleya arizonica* Rose (Addisonia 8:35, pl. 274. 1923) by the narrower calyx-lobes and lighter red of the petals.

Ribes amarum McClatchie, **Erythea** 2:79. 1894.

This shrub from the south face of the San Gabriel and San Bernardino Mts. is characterized by a berry 12-18 mm. thick, subglabrous, and with the spines of the fruit crowded, equal, gland-tipped, 1-2 mm. long.

Var. Hoffmanni Munz, n. var. Bacca manifeste pubescens, cum spinis non confertis, inaequalibus. 1-3.5 mm. longis. Type, Gaviota Canyon, April 28, 1926, *M. E. Jones*, Pomona College Herbarium No. 122692. This variety ranges in the canyons from Gaviota to Carpenteria, and is represented by such collections as *Elmer* 3753 from Santa Barbara; *Munz* 9328 from Mountain Drive, Santa Barbara; and *Jones in* 1929 from Carpenteria. It is named for Mr. Ralph Hoffmann of Santa Barbara, through whose efforts many new things are being added to his region.

Whipplea utahensis Wats., Amer. Nat. 7:300. 1873.

Known previously from Utah, Nevada and Arizona. Can now be reported from Clark Mt., eastern San Bernardino County, where it was collected by *E. C. Jaeger* on June 22, 1930.

Photinia arbutifolia (Ait.) Lindl., Trans. Linn. Soc. 13:103. 1821.

As this species occurs on the mainland, its fruit commonly averages about 6 mm. in diameter. On Catalina and San Clemente Islands the berries are conspicuously larger and finer and there may be recognized.

Var. macrocarpa Munz, n. var. Bacca 8-10 mm. longa. Type, from "Lemon Tank" canyon, San Clemente Island, *Munz* 6759, Pomona College Herbarium No. 18981.

Amelanchier alnifolia Nutt. var. **venulosa** (Greene) Jeps., Man. Fl. Pls. Calif., 510. 1925.

This is the most common form in Southern California, occurring in the San Gabriel and San Bernardino Mts., Topatopa Mts., and the eastern slopes of the San Jacinto and Laguna Mts. It is characterized by villous-tomentose young growth, leaves elliptic-oblong, 1.5-2.5 cm. long; petals oblanceolate, 8-10 mm. long; fruit purplish, 6-10 mm. long. Near to it but apparently different is

Var. cuyamacensis Munz, n. var. Folia oblongo-suborbiculares, 2-4.5 cm. longa; petalis 10-13 mm. longis; fructibus 6 mm. longis. Type, Cuyamaca Lake, *Munz* 8099, Pomona College Herbarium No. 48176 Other collections are French Valley, Palomar Mts., *Munz* 8298; and Cuyamaca, *Spencer* 865; Dark Canyon, San Jacinto Mts., *Munz & Johnston* 8701; Buckmans Springs, *Feudge* 1687.

Var. nitens (Tidestrom) Munz, n. comb. (*Amelanchier nitens* Tidestrom, Proc. Biol. Soc. Wash. 36:182. 1823.) Young growth, ovary, calyx, etc. quite glabrous; leaves bright green, shining, 1-2 cm. long, broadly oval to almost round. Described originally from the Charleston Mts. of southern Nevada, this plant occurs in the Old Dad Mts., *Jones* 25392.

Potentilla Peirsoni Munz, n. nom.

P. cuneifolia (Rydb.) Wolf, Monog. Potentilla, 139. 1908, not Bertol., Misc. Bot. 24:15. 1863. *Drymocallis cuneifolia* Rydb., Monog., 204, pl. 111. 1898.

Since this species must be renamed, it is a pleasure to name it for Mr. F. W. Peirson, whose collections on the desert slopes of the San Gabriel Mts. rediscovered a plant that had not been collected for many years. (See, Munz & Johnston, Bull. So. Calif. Acad. 24:25. 1925.)

Parosela mollis (Benth.) Heller, Cat. N. Am. Pl. ed. 2:6. 1900.

Calyx 3-4 mm. long; corolla slightly longer. Colorado and eastern (rare) Mohave Deserts.

Var. mollissima (Rydb.) Munz, n. comb. (*Parosela mollissima* Rydb., No. Amer. Fl. 24:64. 1919). Calyx 5-8 mm. long; corolla usually included. Mohave and Colorado Deserts to Nevada.

Petalostemon Searlsiae A. Gray, Proc. Amer. Acad. 8:380. 1873.

Heretofore known from Nevada, Arizona and Utah. Collected on May 28, 1930 in a wash in Pahrump Valley in the eastern part of San Bernardino County by *E. C. Jaeger.*

Astragalus Douglasii Gray, Proc. Am. Acad. 6:215. 1864.

Perennial, with procumbent stems 3-6 dm. long; leaves short-petioled, 4-10 cm. long; leaflets 15-25, 1-2 cm. long; peduncles 3-5 cm. long; racemes 5-15—flowered, the flowers not crowded; calyx 4-5 mm. long, the lobes subulate, almost as long as the tube; corolla cream-colored, 8 mm. long; pod thin-walled, elongate-ellipsoid, 3-4 cm. long, 1.5-2 cm. thick, strigulose. Dry slopes and plains above 3000 ft. altitude, in Bear Valley and western end of San Gabriel Mts.; San Miguel Island and South Coast Ranges.

Var. megalophysa (Rybd.) Munz & McBurney, n. comb. (*Phaca megalophysa* Rydb., No. Amer. Fl. 24:344. 1929). Corolla 10 mm. long; pod 5-6 cm. long. Mescal Creek, San Gabriel Mts. to Bear Valley.

Var. Parishii (Gray) Jones, Contr. W. Bot. 8:6. 1898. (*Phaca vallicola* Rydb., No. Amer. Fl. 24:343. 1929; *P. pseudocarpa* Rydb., l. c. *P. Deanei* Rydb., l. c., 355.) Fruiting peduncles spreading, arcuate, with racemes 1 dm. long; calyx-lobes short-deltoid, one-third to one-fourth as long as the tube, white-margined with pubescence; pod fairly firm, 4-5 cm. long. Bear Valley; San Jacinto Mts. to Palomar and Laguna Mts.

Var. perstricta (Rydb.) Munz & McBurney, n. comb. (*Phaca perstricta* Rydb., No. Amer. Fl. 24:344. 1929). Fruiting peduncles ascending, strict, with racemes 1-2 dm. long; calyx as in var. *Parishii;* pod very thin-walled, 5-6 cm. long. Jacumba and Laguna Mts. to Lower California.

Astragalus insularis Kell. var. **Harwoodii** Munz & McBurney, n var.

Annua, expansa, infra ramosa, 1-3 dm. alta, subpurpurea, canescens; foliis 4-6 cm. longis; pinnis 15-21, strigosis, linearo-oblongis, 9-14 mm. longis; racemis cum floribus paucis; pedunculis 2-4 cm. longis; calycibus albostrigosis, lobis lanceolatis; corollis subpurpureis, 6 mm. longis; capsulis oblique ovoideo-lunatis, subpurpureis, strigosis, 1.5-2 cm. longis, 1 cm. latis, sessilibus.

Type from Blythe Junction, Colorado Desert, *Munz & Harwood* 3592, Pomona College Herbarium No. 7587. Growing on sandy flats; collected also at Desert Center, Riverside County, *Jones in* 1924, and at McCoy Wash, *Hall* 5945. It differs from *A. insularis* of Lower California by its purplish tinge, more ashy pubescence, and larger fruits, though these are shaped as in the species.

Astragalus Vaseyi Wats., Proc. Amer. Acad. 17:370. 1882.

Perennial, loosely branched from the base, decumbent, with stems 2-5 dm. long, strigose-canescent throughout; leaves 5-10 cm. long; leaflets oblong to elliptic, 5-20 mm. long, silky-strigose, 9-21; peduncle 5-10 cm. long; calyx silvery-strigose, 5 mm. long, the teeth almost equaling the tube; corolla purple, 7-8 mm. long; pod turgid, oblique-ovoid, sessile, canescent, flattened toward the tip, 10-14 mm. long, 6-7 mm. thick. Dry rocky slopes western edge of Colorado Desert, from Grapevine Springs to Jacumba and Mountain Springs.

Var. metanus (Jones) Munz & McBurney, n. comb. (*A. metanus* M. E. Jones, Proc. Calif. Acad. ser. II, 5:666. 1895). Calyx-hair black, the calyx-teeth tending to be half as long as the tube; pod flattened in upper third. Mountain Springs into northern Lower California.

Var. Johnstonii Munz & McBurney, n. var. Viridior et glabrior; calyce atro-pubescente, tubo 3-4 mm. longo, dentibus subulatis, 1 mm. longis; capsulis membranaceis, strigulosis, 15-22 mm. longis, 8-9 mm. crassis, in apice vix compressis. Type from Keyes Ranch, Little San Bernardino Mts., *Munz & Johnston* 5271, Pomona Collage Herbarium No. 13986. Other collections are: Morongo Pass, *Jaeger in* 1921; Keyes Ranch, *Gilman in* 1926; The Pipes, *Jones in* 1927; Desert Queen Mine, *Jaeger in* 1926: Eagle Mts., *Munz* 4935*a*.

Astragalus pychnostachyus Gray var. **lanosissimus** (Rydb.) Munz & McBurney, n. comb.

Phaca lanosissima Rydb., No. Amer. Fl. 24:357. 1929.

Along the coast, Los Angeles County, as at Ballona. Differs from *A. pychnostachyus* of coastal central Calif. by being silvery white instead of canescent, and having the calyx-teeth one-fourth to one-third as long as the tube instead of half as long.

Astragalus Crotalariae (Benth.) Gray, Proc. Am. Acad. 6:216. 1864.

A. limatus Sheldon, Minn. Bot. Studies 9:126. 1894; not *A. Crotalariae* of most recent authors.

Erect or ascending, perennial, 2-7 dm. high; leaves 1-2 dm. long; leaflets 11-19, oblong to obovate, 1-3 cm. long; peduncles 1-1.5 dm. long; calyx strigose, nigrescent, 7-8 mm. long; corolla reddish-purple, 2 cm. long; pods oblong-cylindric to oblong-ovoid, 1.5-2.5 cm. long, 10-14 mm. wide and thick, subglabrous or strigillose, reticulate-veined, 1-celled, subsessile or with stipe 1-2 mm. long. Common on dry sandy plains, and in washes, Colorado Desert.

Var. Davidsonii (Rydb.) Munz & McBurney, n. comb. (*Phaca Davidsonii* Rdyb., No. Amer. Fl. 24:362. 1929). Corolla 15 mm. long; pod 7-8 mm. wide. Antelope Valley, Mohave Desert.

Astragalus Antiselli Gray, Bot. Calif. 1:152. 1876.

A. Antiselli var. *phoxus* Jones, Contr. Western Bot. 10:65. 1902. *Homalobus MacGregorii* Rydb., Bull. Torrey Club 50:270. 1923). Perennial, erect, few-stemmed; leaves 5-15 cm. long; leaflets 15-31, oblong to elliptic, often subglabrous above; peduncle 5-20 cm. long, raceme crowded at anthesis; calyx 4-5 mm. long; corolla cream-color, 10-14 mm. long; pod strongly compressed, glabrous; linear-elliptic, with both sutures curved, 2-2.5 cm. long, 5-6 mm. wide, with a strigillose stipe 10-15 mm. long. Dry slopes and hills, from Los Angeles to San Luis Obispo Counties.

Var. gaviotus (Elmer) Munz & McBurney, n. comb. (*A. gaviotus* Elmer, Bot. Gaz. 39:54. 1905). Leaves canescent; pods strigose, 6-10 mm. wide, with stipe 6-8 mm. long. Gaviota Pass, Santa Barbara Co Examples: Gaviota, *K. Brandegee in* 1909; The Sisquoc, *M. S. Baker in* 1895; bluffs 20 miles northwest of Santa Barbara, *Munz*. 9293.

Astragalus trichopodus (Nutt.) Gray, Proc. Amer. Acad. 6:218. 1863.

Perennial, erect, 3-6 dm. tall, sparsely strigose; leaves 1 dm. long; leaflets 25-35, oblong, 1-2 cm. long; peduncle 5-15 cm. long, with shorter racemes; corolla whitish, 10-12 mm. long; pods subglabrous, ellipsoid, 2-3.5 cm. long, 1 cm. wide, 4 mm. thick, with both sutures convex, with strigulose stipe 8-10 mm. long. Common on grassy slopes, Santa Ana Canyon to Whittier; occasional northward to South Coast Ranges.

Var. capillipes (Jones) Munz & McBurney, n. comb. (*A. capillipes* M. E. Jones, Revision Astragalus, 117. 1923). Pods 2 mm. thick, upper suture straight. Catalina Island.

Astragalus pachypus Greene, Bull. Calif. Acad. 1:157. 1885.

With heavy wooded caudex; stems several, erect, stout, 3-8 dm. tall, silvery-strigose; leaves glabrate, 5-12 cm. long; leaflets 13-21, linear; peduncles 1-2 dm. long; calyx partly black-hairy; corolla whitish, 1.5 cm. long; pod coriaceous, compressed, oblong, almost 2-celled, 2 cm. long, 5 mm. wide, slightly arcuate, with both sutures prominent and cord-like, and with stout stipe 5-7 mm. long. Dry slopes and ridges, from region of Mt. Pinos, Lebec, Tehachapi, etc. northward.

Var. Jaegeri Munz & McBurney, n. var. Corolla aurea, 12-13 mm. longa. Type, from dry slopes on divide east of Dripping Springs, Riverside County at 1700 ft., *Munz* 9842, Pomona College Herbarium No. 97119. Other specimens: Temecula, *Parish* 1134; Aguanga, *Jaeger in* 1925; Dripping Spring, *Munz* 5118; Lamb's Canyon near Banning, *Spencer* 1771.

Astragalus Peirsonii Munz & McBurney, n. sp.

Annua, erecta, 3-6 dm. alta, albo-strigulosa; foliis 5-9 cm. longis; rhachibus complanatis, 1-1.5 mm. latis; pinnis 9-13, parvis, oblongis aut linearibus, 2-6 mm. longis, 0.5-1.5 mm. latis, subsericeis; pedunculis 6-10 cm. longis; calycibus 4-5 mm. longis; lobis 1-1.5 mm. longis, lanceolatis aut subulatis; corollis 10-12 mm. longis, subpurpureis aut roseis; capsulis membranaceis, albis, 2-2.5 cm. longis, 1.5 cm. crassis.

Type from sand dunes between Holtville and Yuma, Imperial County, *Munz & Hitchcock* 12132, April 5, 1932, Pomona College Herbarium No. 179,250. Other collections from the same region: *Peirson* 7194, *Gilman in* 1928, *Jones in* 1926. It was Mr. Peirson's collection that first made me realize the distinctness of this plant. It is nearest to *A. Coulteri* Benth. but differs in being annual, in having a flattened rachis, and the leaflets reduced to linear-oblong structures not over 6 mm. long (in *A. Coulteri* they are obovate, 8-12 mm. long), and in the corolla being 10-12 mm. rather than 13-15 mm. long.

Linum puberulum (Engelm.) Heller, Plant World 1:22. 1897.

This yellow-flowered Linum can now be added to the flora of the state, having been collected on rocky hills, 30 miles east of Baker, Mohave Desert, on May 25, 1930 by Arthur and French Gilman.

Polygala subspinosa Wats., Amer. Nat. 7:299. 1873.

Hitherto known from Nevada and Arizona at the westernmost stations, this is now brought to our borders at Chloride Cliff, Death Valley, *Jaeger* 1101.

Euphorbia polycarpa Benth., Bot, Voy. Sulphur., 50. 1844.

Glabrous prostrate perennial; leaves 2-5 mm. long, stipules lanceolate, ciliate, free appendages broader than the purplish glands; capsule 1.5 mm. long; seeds oblong, 4-angled. Frequent on dry slopes and mesas San Diego to Pasadena and Riverside.

Var. appendiculata (Engelm.) Munz, n. comb. (*E. cinerascens* var. *appendiculata* Engelm., Bot. Mex. Boundary, 186. 1859. *E. polycarpa* var. *vestita* Wats., Bot. Calif. 2:73. 1880. *E. melanadenia* Torr., Pac. R. R. Rep. 4:135. 1857.) Stems ascending; herbage hoary with appressed pubescence. Dry stony hillsides, along south front of Santa Monica and San Gabriel Mts. to Arizona.

Ceanothus megacarpus Nutt. var. **insularis** (Eastw.) Munz, n. comb.

C. insularis Eastw., Proc. Calif. Acad., ser. IV, 16:362. 1927.

Leaves often opposite, 1.5-4 cm. long, 1-1.5 cm. wide; capsules scarcely if at all horned. Catalina, Santa Cruz and Santa Rosa Islands. Differing from *C. megacarpus* of the mainland, which has leaves 1-2 cm. long and capsules with 3 conspicuous divergent horns, but intergrading with it, especially on Catalina Island and in the Santa Monica Mts.

Colubrina californica Johnston, Proc. Calif. Acad., ser. IV, 12:1085. 1924.

This Arizona and Lower California species grows in canyons at the southeastern end of the Eagle Mts., Riverside County, *Jaeger in* 1930 and *Johnston* 3788.

Glossopetalon pungens Brandegee, Bot. Gaz. 27:445. 1899.

So far as I know this species has been reported only from the Sheep Range of southern Nevada. In June, 1930 it was collected by *E. C. Jaeger* on Clark Mountain, in the eastern Mohave Desert, San Bernardino Co., California.

Sphaeralcea ambigua Gray, Proc. Amer. Acad. 22:292. 1887.

Panicles crowded; calyx 6-12 mm. long; petals brick red, 10-20 mm. long. Common in canyons and on dry slopes and mesas, Mohave Desert and western edge of Colorado Desert; to Arizona and Nevada.

Var. Keckii Munz, n. var. Panicula laxa; calycibus 12-20 mm. longis; petalis 2-3 cm. longis. Type, from Corn Springs, Chuckwalla Mts., Colorado Desert, *Munz & Keck* 4835, Pomona College Herbarium No. 14103. Common from Needles to Blythe and Salton Sea.

Gilia Jaegeri Munz, n. sp.

Humilis, caespitosa, sublignosa; ramis numerosis, 2-5 cm. altis, glanduloso-pubescentis, denso foliosis; foliis fere oppositis, 1-1.5 cm.

longis, cum 3 lobis complanatis, lobo terminale 6-7 mm. longo, lobis lateralis 4-6 mm. longis; floribus confertis, in axillis superioribus solitariis; calycibus 8-9 mm. longis, inter lobis membranaceis; lobis calycis complanatis, inaequalibus, spinosis; corollis manifeste albis, anguste infundibuliformibus, ca. 2 cm. longis, tubis 12 mm. longis, lobis 7-8 mm. longis, late oblanceolatis; staminibus in tubo superiore insertis, in fauce inclusis, parte libera filamentorum 2-3 mm. longa; antheris ca. 0.6 mm. longis; stylis 2 mm. longis; stigmatibus 3 mm. longis; capsulis oblongis, 2 mm. longis; seminibus non visis.

Type, from Tahquitz Peak, San Jacinto Mts., July 1, 1921, collected by *Jaeger*, sent to Gray Herbarium by Mary F. Spencer under *G. pungens*. No. 1726. This proposed species resembles *Phlox austromontana* in habit, but seems to be a very distinct species of Gilia in the section Leptodactylon, peculiar in its flattened leaves and low stature.

Salvia Brandegei Munz, n. nom.

Audibertia stachyoides var. *revoluta* Brandg., Proc. Calif. Acad., ser. II, 1:216. 1888. *Salvia mellifera* var. *revoluta* Munz, Bull. So. Calif. Acad. 26:23. 1927. Not *S. revoluta* Ruiz & Pavon.

After having seen this species growing on Santa Rosa Island, I am convinced that it possesses characters sufficient to warrant its specific segregation from *S. mellifera* Jeps. The corolla is widely gaping, lavender not bluish, the stamens are scarcely exserted, the corolla-tube has hair well distributed within and not in a narrow band, the leaves are strongly revolute. In fact the whole appearance of the growing shrub is not suggestive of *S. mellifera*.

Castilleja miniata Dougl. var. **oblongifolia** (Gray) Munz, n. comb.

C. oblongifolia Gray, Syn. Fl. N. Am., vol. 2, pt. 1:296. 1878. *C. montana* Congdon, Erythea 7:188. 1900.

A study of the type of *oblongifolia* at Gray Herbarium reveals it to be nothing more than an unusually broad-leaved plant of the southern form of *C. miniata*. Most California material differs from typical *miniata* of the region to the north by a more compact spike and more erect galeas. Our local plants which have been treated by various authors as *C. oblongifolia* should be called *C. Martini* Abrams.

Solanum Wallacei (Gray) Parish, Proc. Calif. Acad., ser. III, 2:164. 1901.

This species is characterized by its tawny viscid-villous pubescence, large oblong-ovate leaves; calyx 5-6 mm. long; corolla 2-4 cm. wide; fruit dark purple, 1.5-2.5 cm. thick. It is apparently confined to Catalina Island.

Solanum Clokeyi Munz, n. nom.

S. arborescens Clokey, Bull. So. Calif. Acad. 30:60. 1931; not *S. arborescens* Moench.

Like *S. Wallacei* in foliage, somewhat less viscid-villous; calyx 3-4 mm. long; corolla 1.5-2 cm. wide; fruit yellow, 1-1.5 cm. thick. I have seen material from Santa Cruz Island only.

Solanum Xanti Gray, Proc. Amer. Acad. 11:90. 1876.

Leaves ovate, the stems short-villous with white, mostly non-glandular hairs; calyx 5-6 mm. long; corolla 1.5-3.5 cm. wide; berry greenish, 6-8 mm. thick. Open places in chaparral, about oaks, etc., Bouquet

Canyon and Gorman Station through Ventura and Santa Barbara Counties and western Kern Co. to San Luis Obispo Co.; Santa Rosa and Santa Cruz Islands. Intergrading freely with

Var. intermedium Parish, Proc. Calif. Acad., ser. III, Bot., 2:168 1901. Stems and leaves short-pubescent, with gland-tipped hairs. Below 3500 ft., Santa Monica Mts. to San Bernardino Valley.

Var. montanum Munz, n. var. Caules herbacei, non lignosi, 1-4 dm. longi, saepe prostrati, cinereo-pubescentes. Type, from north side of Bear Valley, San Bernardino Mts., *Munz* 5718, Pomona College Herbarium No. 13481. Growing at between 6000 and 8500 ft. in the San Bernardino and San Gabriel Mts.

Var. Hoffmanni Munz, n. var. Glabra; foliis oblongo-ovatis, 3-6 cm. longis, acutis. Type from Gaviota Pass, Santa Barbara Co., *Munz* 9315, Pomona College Herbarium No. 98450. Other collections from the same region are *Abrams* 10895 and *Elmer* 3957.

Var. glabrescens Parish, l. c., 169. (*S. Xanti* var. *Spencerae* Macbr., Contr. Gray Herb. NS., 65:43. 1922). Subglabrous; leaves lance-ovate to oblong-lanceolate, 1-2 (4) cm. long, obtuse. Interior valleys, San Bernardino and Riverside to Lower California and San Diego; interior central California.

PROCEEDINGS OF THE ACADEMY

February to May, 1932

FEBRUARY 11:

Regular meeting of the Academy was held in the auditorium of the Library at 8 p. m. Being the day following the birthday of one of our greatest presidents, the evening was given to a memorial to the "Great Emancipator."

Dr. F. D. Blakeslee was the guest speaker, using as his subject "Personal Recollections of Lincoln." The speaker is one of the fast-dwindling group of persons who can boast of the memory of personal contact with Lincoln. He told of dealings with the president as an employee of the government near the close of the Civil War. Personal anecdotes illustrating the inate wisdom and depth of the soul of Lincoln were dramatically told.

March 12:

Regular meeting of the Academy was held in the Library at 8 p. m. The lecture of the evening was "Legends of the Wild Flowers and Cacti" by Frank A. Schilling. The talk was illustrated by beautifully colored lantern slides, made by the speaker, who is one of our outstanding students of local natural history. Interesting and poetic associations, chiefly from Indian lore, relative to our West Coast flora, made this a most enjoyable meeting.

April 9:

The regular meeting of the Academy was held in the auditorium of the Library at 8 p. m. The Secretary was called upon to inform the members present of the great loss sustained by the Academy in the sad passing of Dr. Anstruther Davidson, whose active interest and valuable support of that organization from its beginning over four decades ago, have been to a large measure the reason for its success. The meeting stood in silence for a minute in tribute to this lovable character.

Philip Johnston, well-known author and student of the Indians of the Southwest, gave a beautifully illustrated talk on "The Indians of the Enchanted Desert." It was an intimate study of the Land of the Navajos. The speaker spent his early life among this people, serving as a government interpreter in later years. He gave examples of their songs, art and picturesque life. Those who have regularly attended the meetings of the Academy were agreed in that it was the most interesting and instructive presentation of the life and mind of the Indian ever given before our group.

May 14:

Regular meeting of the Academy was held in the Library at 8 p. m. Dr. F. H. Maude, one of our members of long standing, and noted speaker and photographer of the scenic grandeur of our West, spoke on "Prehistoric Dwellings of the Southwest." The talk was illustrated by lantern slides, and dealt with recent archeological "finds" in the cliff dwellings and village sites, together with artifacts and building methods of the inhabitants of Arizona and New Mexico before the coming of the Spaniards. Dr. Maude has spent many years in the careful study of this area and gave much material not heretofore published.

Dr. R. H. Swift, *Secretary.*

The work of the Southern California Academy of Sciences is carried on entirely through the generosity of private citizens, who are sufficiently interested in the advancement of education and cultural endeavor to donate funds or make bequests to the Academy. As a guide, in the matter of bequests, for those who plan to further this program, the following forms are suggested:

Form of Legacy

To be used when it is desired to leave the Academy any personal property, such as money, stocks, bonds, works of art, or other objects of value.

I give and bequeath unto "Southern California Academy of Sciences," of the City of Los Angeles, the sum of..... Dollars: To have and possess the same unto the said "Southern California Academy of Sciences," its successors and assigns, to the uses, dispositions and benefits thereof forever.

Form of Devise

To be used when it is desired to leave real estate to the Academy.

I give and devise to "Southern California Academy of Sciences" of the City of Los Angeles, (..... here describe the property or ground rent.....), together with the appurtenances, in fee simple, and all policies of insurance covering said premises, whether fire, title or otherwise, free from all taxes: To have and to hold the same unto the said "Southern California Academy of Sciences," its successors or assigns forever.

BULLETIN of the SOUTHERN CALIFORNIA ACADEMY of SCIENCES

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Publications of the
Southern California Academy of Sciences

The Academy has published to date the following:

PROCEEDINGS. 1896 to 1899. Six numbers—Vol. 1, Nos. 1 to 6.
MISCELLANEOUS BULLETINS issued under the imprint of the Agricultural Experiment Station—1897 to 1907. Ten numbers.

All issues of the above are now out of print.

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Bulletin of the
Southern California Academy of Sciences

Began issue with Vol. I, No. 1, January, 1902. Issued ten numbers in 1902, nine numbers in 1903, 1904, 1905; three numbers in 1906. Issued two numbers annually from 1907 to 1919, both inclusive (except 1908—one issue only). Issued four numbers (January, May, July and October) in 1920.

The 1921 issues are: Vol. XX, No. 1, April; Vol. XX, No. 2, August; Vol. XX, No. 3, December.

The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

The 1923 issues are: Vol. XXII, No. 1, March; No. 2, July.

The 1924 issues are: Vol. XXIII, No. 1, January-February; No. 2, March-April; No. 3, May-June; No. 4, July-August; No. 5, September-October; No. 6, November-December.

From 1925 to 1931, including volumes XXIV to XXX, three numbers were published each year. These were issued as No. 1, January-April; No. 2, May-August; No. 3, September-December, for each volume

All of the issues listed on previous page are now out of print, with the exception of the following, which may be secured from the Secretary of the Academy at the appended prices:

Vol.	3,	No.	7.	October	1904	$ .25
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"	24,	"	2.	May,	1925	.25
"	24,	"	3.	September,	1925	.25
"	25,	"	1.	January,	1926	.75
"	25,	"	2.	May,	1926	.25
"	25,	"	3.	September,	1926	.25
"	26,	"	1.	January,	1927	.25
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The Academy is desirous of completing its files in certain issues and will appreciate the donation of all numbers by members who have no further use for back issues. Address all communications concerning the above to:

DR. JOHN A. COMSTOCK

Southern California Academy of Sciences, Care of Los Angeles Museum, Exposition Park, Los Angeles, California.

BULLETIN OF THE

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LOS ANGELES, CALIFORNIA

Vol. XXXI September-December, 1932 Part 3.

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Issued December 30, 1932

Southern California Academy of Sciences

OFFICE OF THE ACADEMY

Los Angeles Museum, Exposition Park,
Los Angeles, Cal.

A LIST OF THE COLEOPTERA OF FORT TEJON, CALIFORNIA

By A. C. Davis

In the early days of California settlements were few and widely spaced, transportation was not nearly so easy as it is today, and it was difficult for the naturalist to ramble about over the country collecting here and there at will. For this reason many of our early insect collections were made in definite areas, the collectors using some settlement as a base from which to work the surrounding country. Thus there are certain places that are called "type localities" for many of our Californian species. Among these are Fort Ross, San Francisco, San Diego, and Fort Tejon.

Fort Tejon lies in latitude 34° 55′ N. and longitude 118° 53′ W., at an elevation of 3,245 feet. It is roughly 5 miles north of the summit of the pass, and 40 miles south of Bakersfield. The narrow canyon in which the fort is built constitutes a "bottleneck" on the main inland route between northern and southern California, and is the entrance to one of the few passes through the mountains which separate the two portions of the state. A great amount of collecting was done at Fort Tejon in the early days of California and it is the recorded type locality for many plants and animals as well as insects. It is probable that, had the early collectors been more exact in assigning localities to their specimens, there would be many more types from this place.

In the years 1857 and 1858 John Xantus de Vesey collected at Fort Tejon for the Smithsonian Institution, and took large numbers of specimens of all kinds. It was from the results of this collecting, probably supplemented by the results of his own collecting here in 1850, that Leconte, in 1859, compiled his "Catalogue of the Coleoptera of Fort Tejon." About 1853 or 1854 Lieut. R. S. Williamson's party collected through Tejon Valley. Dr. Geo. H. Horn was stationed here as surgeon, U. S. Army, from 1855 to 1857, and collected a great number of beetles. In the seventies W. D. Henshaw visited the fort, and the Death Valley Expedition passed through here in 1891.

Because of its important place in the history of zoology in California a few brief notes on the history of the fort itself might not be amiss.

Fort Tejon was not built in the original Tejon Pass, which lies about 15 miles to the eastward. In 1853 there was a road through the old Tejon Pass, described by Williamson (8) as "the worst I ever saw," and a trail through what is known as the *Cañada de las Uvas,* or Grapevine Canyon, through which packtrains passed to Los Angeles. Williamson reconnoitered both

routes and found that, while the *Cañada* was lower than many possible passes, the Tejon was to be preferred for a railroad because, although the altitude was greater, both the ascent and descent were gentle. The *Cañada* was, however, found to be better for a wagon road to Los Angeles, and from that time on the bulk of the wagon traffic went by that route, and the name Tejon was transferred to it (7). The railroad pass is now called the Teháchapi.

The trail through Grapevine Canyon is very old, and was in use by the natives before the arrival of the Spaniards. It is believed that the first white man to pass through it was Don Pedro Fages, Military Commander of Upper California, who was in this country in 1772 in search of runaway neophytes from the missions on the coast. Four years later, in 1776, Fr. Francisco H. Garcés went by this route on his way northward after his long journey over the deserts. In 1806 the route was used by expeditions prospecting for locations for an inland chain of missions. Among these explorers were Fr. Pedro Muñóz of Mission San Miguel, and Fr. Jose Maria de Zalvidea, with a party of soldiers (3). From time to time the *Cañada* has been used by a number of persons of fame or notoriety. Fremont did not enter southern California by this route, but by the original pass. Joaquin Murietta went by this route, no one knows how often, but it was probably always hastily. Later came the forty-niners from the southern route across the Mojave Desert, for whom this was a main route to the gold fields of central and northern California, and the Butterfield Stages between Los Angeles and San Francisco.

Little or no trace of the old immigrant trail now remains. The concrete State Highway leads from the Ridge Route through the extreme western end of Antelope Valley (the western arm of the Mojave Desert)—from which, by the way, the antelope have long been missing—over the summit of the pass and down a rather wide valley past Lebec, within about 300 yards of the fort, which is in a small tributary valley to the west of Grapevine Creek, and is hidden by the trees, and on down the grade to Rose Station and Bakersfield. About 2 miles south of the fort the canyon widens out, forming a fairly large, level, marshy area, at the eastern end of which is Castaic Lake, a broad, shallow pond that frequently dries up in summer. The Grapevine Canyon is the very narrow outlet for all this watershed, and is rather marshy in many places, with grassy meadows and many huge oaks, about half of which are now either dead or dying. From the meadows the bare rocky hills rise very steeply.

Fort Tejon was built between 1852 and 1854, the exact date varying as given in different letters and publications, some apparently taking the date that construction was started, others taking the date of its completion. It was occupied by troops for the purpose of protecting immigrant trains and freight outfits from the attacks of the bands of bandits and renegade Indians that

then infested the country about the mountain passes. It having been found impracticable to use foot troops in this type of warfare, seven companies of the 1st U. S. Dragoons were sent from Fort Union, on the Rio Grande, to the Division of the Pacific, where they arrived late in 1856. Two companies (A, and perhaps B) under Maj. W. H. Grier and Capt. Whittlesley, Maj. G. A. Blake in command, were stationed at Fort Tejon (2).

Lieut. R. S. Williamson, Corps of Topographic Engineers, and his party, which was making a survey to determine the practicability of a route for a railroad to connect with the routes near the 35th and the 32nd parallels, and also collecting zoological material, was in this part of the country in 1853, and camped upon the site of the fort, which may have been even then under construction. Lieut. E. F. Beale, who was later to become the owner of this property, arrived while they were there. Williamson records that "one of the large oak trees bears the inscription, cut deeply into the hard wood: 'Peter le Beck, killed by a bear, Oct. 17, 1837.' A broad flat surface was hewed upon the trunk and well smoothed off before the letters were cut. It is a durable monument." This is presumably the LeBeck for whom the town (if it may be called so) of Lebec is named.

The original fort must have been quite a large establishment. It was laid out in a quadrangle about 150 yards across, and seems to have consisted of about 20 buildings. The officers' quarters formed most of the west side, the barracks formed most of the south side, and the sutler's store, quartermaster's storehouse, guardhouse, hospital, etc., formed the other two sides. All of these buildings were of adobe construction with foundations of stone and they seem at one time to have been connected by an adobe wall about 8 feet high. They are said to have had burned-tile floors and roofs. All joists and rafters and other heavy woodwork still in place are of oak, the joints carefully dovetailed and secured with oak dowels. From what can be seen at the present time the work seems to have been done by tradesmen of the very first class. All construction was done by contract, and the Government is said to have spent between $60,000 and $80,000 for construction alone, and $400,000 or $450,000 in maintenance at and about the fort.

In 1857 a very severe earthquake occurred. Newmark (6) says that "at Fort Tejon great rents were opened in the earth and closed again, piling up a heap or dune of finely powdered stone or dirt. * * * Many officers, including Col. B. L. Beal, barely escaped from the barracks with their lives, and until the cracked adobes could be repaired officers and soldiers lived in tents." At this time, although some of the outbuildings, quarters of government employees, and settler's homes were destroyed, the main buildings at the post did not fall. Most of the damage was repaired.

On June 15, 1861, the post was evacuated.

On May 17, 1863, Brewer (2) wrote that many of the buildings were already falling to ruin.

On August 17, 1863, the post was reoccupied by troops, and was finally abandoned on September 11, 1863. Fort Tejon was never officially declared a military reservation, and was, furthermore, found to have been built upon private land, part of an old Spanish grant. This grant was later confirmed to a Mr. Bishop.

In 1852 E. F. Beale was appointed General Superintendent of Indian Affairs for California and Nevada by President Fillmore. He established a reservation near Fort Tejon and later acquired large holdings in this area, buying up the land at about five cents an acre from non-resident Spanish and Mexican owners. He was later appointed Surveyor-General of California. In 1865 he resigned his Surveyor-Generalship and retired to Tejon Rancho (200,000 acres). At some later date the fort itself was acquired by the Tejon Rancho, as it is now a part of their property.

In 1905 Grinnell (4) wrote that the tile roofs had been removed and the adobe walls were pretty well in ruins. Much of the lumber, such as floors, etc., was also gone. The work of destruction started by the elements and by vandals has been nearly completed in late years by the removal of such adobe bricks as were in good condition, many of these going into the construction of a sort of glorified "hot-dog" stand near the highway. The only buildings now standing are the officer's quarters, the Adjutant's office (altered almost beyond recognition in an attempt to make a modern dwelling of it), and a barracks for two troops of cavalry. The latter has long been used as a stable, and is rapidly falling to pieces.

It is interesting to note that Fort Tejon was one of the places in the West where camels were in use for transportation across the desert, the fort having had a herd of 28 of these animals at one time. They were brought to this country, presumably at the request of Lieut. E. F. Beale, by Jefferson Davis, who was then Secretary of the Navy. They were landed at Indianola, Texas, in February, 1857 (5), and brought overland by Lieut. Beale, arriving at Los Angeles on January 8, 1858. They were used regularly for freighting between the fort and Los Angeles, and also made several trips to Albuquerque, New Mexico. Some of the wild tales concerning these beasts are amusing. For example, the Los Angeles Star for July 21, 1858, carried the following item: "The camels, eight in number, came into town from Fort Tejon after provision for that camp. The largest ones pack a ton and can travel 16 miles an hour."

The records of Coleoptera from Fort Tejon are found mainly in J. L. Leconte's "Catalogue of the Coleoptera of Fort Tejon, California," a list of species collected by Xantus in 1857 and

1858, probably as has been stated, supplemented by Leconte's own collecting here in 1850. This paper, published in the Proceedings of the Academy of Natural Sciences of Philadelphia (1859, pp. 69-90), is rare and expensive. It lists 147 species in all, 52 of which are described as new. Of these, 5 are now placed as synonyms and a number of others have been shifted to other genera in the years since the paper was published. It is probable that, if some one with a large library at his disposal and with the necessary time and patience, should go through the writings of Leconte, Horn, and others of the earlier coleopterists, many additions might be made.

The present list is by no means exhaustive, being Leconte's list brought up to date, with the addition of such species as I have taken myself, or such as have been collected by others and the records given to me, and with brief collecting notes in some cases.

The most striking thing about the vicinity of the fort from the collector's viewpoint is the remarkably poor collecting. It is quite the usual thing to have to work hard for what one collects in southern California, but to work hard and not "get" is the rule at Fort Tejon.

I am greatly indebted to Mr. H. C. Fall, of Tyngsboro, Mass., who checked over most of the material collected at the Fort, and to Dr. E. C. Van Dyke, of the University of California, who identified some of the Elateridae for me.

In the present list, for the sake of brevity, the following designations will be used: L—listed by Leconte; D—collected by A. C. Davis; V—collected by Dr. E. C. Van Dyke. Species marked with an asterisk are those described as new by Leconte in his list.

Omus californicus Esch. (L). This is the southermost inland record for *Omus* in California.

Cicindela oregona Lec. (D). One specimen taken along Grapevine Creek.

**Brennus crenatus* (Mots.) var. *striatus* (Lec.) (L).

**Brennus punctatus* (Lec.) (L).

Callisthenes latipennis (Horn) (D). Common in the spring throughout this whole region.

Bembidion conspersum Chd. (D).

Bembidion flavopictum Mots. (D).

Bembidion versicolor (Lec.) (D).

Bembidion dubitans (Lec.) (D).

Bembidion, one dubious species (D).

Bembidion, one undescribed species (D).

All of these last six were taken at light or along the banks of Grapevine Creek in summer or late spring.

Tachys edax Lec. (D).

Pterostichus castanipes Mén. (L).

Pterostichus horni Lec. (V). Taken under logs at the edges of the meadows about the fort. Fort Tejon may well be the type locality for this species, as "Southern Sierras" are mentioned.

Pararguter lustrans (Lec.) (L).

Celia californica (Dej.) (D). Taken under cow chips in the pasture back of the fort.

Celia aurata (Dej.) (D). This species is very common under cow chips, stones, etc., especially on the flats below the fort, near Rose Station.

Amara insignis Dej. (D). Taken commonly under tree trunks, etc., about the fort.

Calathus ruficollis var. *obscurus*. Lec. (L, D). Not common under stones along the creek.

Platynus brunneomarginatus Mann. (L, D). Under stones, etc.

Platynus californicus (Dej.) (L).

Platynus fossiger (Dej.) (L, D). Taken at light near Rose Station.

Chlaenius variabilipes Esch. (L, D). Taken occasionally along Grapevine Creek.

Anisodactylus consobrinus Lec. (L).

Anisodactylus similis Lec. (L).

Dicheirus piceus Mén. (L).

Glycerius nitidus (Dej.) (L).

Stenocellus californicus (Lec.) (L).

Peltodytes callosus (Lec.) (D).

Bidessus affinis (Say) var. *nigrinus* Csy. (D). Taken in Grapevine Creek.

Coelambus lutescens (Lec.) (D). Not uncommon in Grapevine Creek. Taken also at light.

Helophorus sp. Two specimens were taken in Grapevine Creek.

Berosus infuscatus Lec. (D). Common in Grapevine Creek.

Hydrous triangularis (Say) (L, D). A few specimens seen about lights at Rose Station.

Tropisternus dorsalis Brullé (D).

Tropisternus sublaevis (Lec.) (D).

Tropisternus californicus (Lec.) (L, D).

All of the species of *Tropisternus* occur in fair numbers in Grapevine Creek.

Laccobius ellipticus Lec. (D). Common in the creek.

Cercyon fulvipennis Mann. (D). Taken in numbers in cow dung.

Necrophorus pustulatus Herschel var. *nigritus* Mann (L).

Platystethus americanus Er. (D).

Bledius strenuus Csy. (D).

Bledius flavipennis Lec. (D).

Lathrotaxis californica (Lec.) (D).

Dachnochilus sp. (D).

Stilicus occiduus Fall (D).

Baryodma bimaculata Grav. (D).

Hister sellatus Lec. (D). Not uncommon under fresh cow dung, and along Grapevine Creek, on the sand.

Hister sexstriatus Lec. (L).

**Hister remotus* Lec. (L).

Hister bimaculatus Linn. (D). Common under cow dung.

**Hetaerius morsus* Lec. (L).

Saprinus lugens Er. (L).

Saprinus oregonensis Lec. (L, D).

Saprinus lubricus Lec. (L, D).

The last two species are very common under partly dried cow dung.

Podabrus tomentosus (Say) (L).

**Podabrus tejonicus* Lec. (L).

Silis cava Lec. (D).

Malthodes sp. near *vigilans* Fall (D). Swept from grass in the meadow in front of the fort in May.

**Malachius mirandus* (Lec.) (L, D). Beaten from a composit flower. Fairly plentiful.

**Tanaops abdominalis* Lec. (L).

Attalus lobatulus (Lec.) (D). Beaten from trees about the fort.

Attalus sp. (D).

**Trichochrous quadricollis* (Lec.) (L).

Trichochrous sordidus (Lec.) (L).

Trichochrous squalidus (Lec.) (L).

Listrus luteipes (Lec.) (L, D). Common on oaks and other plants, by beating.

Dasytastes seminudus Lec. (D).

Dasytastes sp., near *remissus* Csy. (D).

Dasytastes sp., probably undescribed (D).

Eschatocrepis constrictus (Lec.) (L).

**Allonyx sculptilis* (Lec.) (L, D). Plentiful upon the flowers of a species of poppy.

Rhadalus testaceus Lec. (L, D)

Cymatodera umbrina Fall (D). Beaten from oak.

**Cymatodera ovipennis* Lec. (L).

Enoclerus eximius Mann. (L).

Enoclerus laetus Klug var. *abruptus* Lec. (D). Common on the flowers of a species of composit.

Trichodes ornatus Say var. *tenellus* Lec. (L, D). Fairly common about flowers.

Hydnocera scabra Lec. (D).

Hydnocera affiliata Fall (D).

These two species were beaten from oak in small numbers.

Necrobia rufipes (DeG.) (L).

Asclera excavata Lec. (L).

Mordella scutellaris Fab. (L).

**Anthrobates nubilus* Lec. (L).

Anaspis atrata Champ. (L).

Macrosiagon cruentum (Germ.) (D). Taken from flowers of wild buckwheat.

Epicauta puncticollis (Mann.) (L).

Lytta vulnerata (Lec.) (D). Common on compositae.

Lytta incommoda Horn (?) (D). One fragmentary specimen found under a cow chip.

Lytta stygica (Lec.) var. *smaragdula* Lec. (L). Frequent on flowers of *Escholtzia californica,* upon which the adults feed.

Nemognatha scutellaris Lec. (L).

Pedilus punctulatus (Lec.) (L).

Pedilus flexiventris Fall (D). Swept from grass in the meadow in front of the fort, May.

Notoxus calcaratus Horn (D). Not uncommon by beating and at light.

Anthicus sp. near *nitidulus* Lec. (D).

Anthicus californicus Laf. (D).

Anthicus sp. near *punctulatus* Lec. (D).

Anthicus seminotatus Csy. (D).

Anthicus obliquus Csy. (D).

All of the species of *Anthicus* were beaten from oaks about the fort.

Euthysanus lautus Lec. (L).

**Octinodes frater* (Lec.) (L).

**Aplastus speratus* Lec. (L, D). At light.

Aplastus, undescribed species (D).

Aeolus livens (Lec.) (D).

Pheletes hispidus (Lec.) (L).

Athous excavatus Mots. var. *axillaris* Horn. (D).

Hypnoides pectoralis (Say) var. *inops* (Lec.) (D).

Melanactes densus Lec. (L).

Crigmus lecontei Horn (coll. by G. Linsley).

Dolopius lateralis Esch. var. *subustus* Lec. (L).

**Sericus silaceus* (Say) (L). This species was described by Leconte as *Sericosoma debilis.*

Agriotes torquatus Lec. (D).

**Elater cordifer* Lec. (L).

Anchastus cinereipennis (Esch.) (D).

**Cardiophorus tenebrosus* Lec. var. *fulvipes* Lec. (L).

Horistonotus basalis Horn (D). Taken beneath cow chips. Rare.

**Acmaeodera acuta* Lec. (L). Described as *A. retifera.*

Acmaeodera connexa Lec. (L).

Acmaeodera guttifera Lec. (L).

Acmaeodera gemina Horn (D). Rare on the hill back of the fort.

Glyptoscelimorpha marmorata Horn (D). Beaten from *Juniperus* on the hill back of the fort.

Hesperorhipis albofasciatus Fall (D). One specimen beaten from mistletoe.

**Anthaxia aenogaster* Cast. (L, D). Described by Leconte as *A. strigata.*

Helichus productus Lec. (D). Common in Grapevine Creek.

Heterocerus gnatho Lec. (D). Taken commonly by washing along the banks of the creek.

Byturus grisescens Jayne (L, D). Common on oak.

Dermestes marmoratus Say. (L).

Dermestes caninus Germ. var. *mannerheimi* Lec. (L).

**Attagenus rufipennis* Lec. (L).

Anthrenus scrophulariae (Linn.) (D).

Anthrenus lepidus Lec. (L).

Temnochila virescens (Fab.) var. *chlorodia* Mann. (L).

**Cateretes sericans* (Lec.) (L).

Carpophilus pallipennis (Say) (L).

**Carpophilus discoideus* Lec. (L). Described as *C. caudalis.*

**Nitidula ziczac* Say var. *humeralis* Lec. (L).

Brontes dubius Fab. var. *truncatus* Mots. (L).

Atomaria sp. (D).

Melanophthalma americana Mann. (D).

**Aphorista morosa* (Lec.) (L).

Hyperaspis octonotata Csy. (D).

Hyperaspis fastidiosa Csy. (D).

Hyperaspis osculans Lec. (D).

Hyperaspis taeniata Lec. var. (D).

Hyperaspis sp. near *spiculinota* Fall (D).

Hyperaspis annexa Lec. (D).

Hyperaspis two undetermined species. All of the species of *Hyperaspis* were beaten from trees about the fort.

Hyperaspidius sp. near *conspiratus* Csy. (D).

Stethorus picipes Csy. (D).

Scymnus pallens Lec. (D).

Scymnus sp. near *ardelio* Horn (D).

Scymnus sp. near *pacificus* Cr. and *strabus* Horn (D).

Scymnus, three undetermined species (D).

All of these small Coccinellidae were beaten from oaks.

Ceratomegilla vittigera Mann. (D).

Hippodamia convergens Guér. (L, D).

Hippodamia convergens var. *punctulata* Lec. (L).

Hippodamia convergens var. *ambigua* Lec. (D).

Coccinella transversoguttata Fald. var. *californica* Mann. (D).

Exochomus histrio Fall (D).

**Stenochidus cyanescens* (Lec.) (L).

**Hymenorus punctulatus* Lec. (L, D). Taken in fair numbers at light.

**Pseudocistela opaca* (Lec.) (L).

Isomira variabilis Horn (L). Recorded in Leconte's list as *Cistela sericea,* an eastern species.

Metoponium bicolor Horn (D).

Edrotes ventricosus Lec. (L).

Phloeodes diabolicus Lec. (L, D).

**Phloeodes pustulosus* Lec. (coll. by A. T. McClay) (L).

**Noserus plicatus* Lec. (L).

Nyctoporis carinata Lec. (L).

**Euschides lecontei* (Horn) (L, D). Described by Leconte as *Pelecyphorus costipennis,* a preoccupied name. Tejon is nevertheless the type locality. The beetle is very common about the fort in the spring and early summer.

**Eulabis rufipes* Esch. (L).

Eleodes quadricollis Esch. (L).

Eleodes dentipes Esch. (L).

Eleodes armata Lec. (D).

Eleodes acuticauda Lec. var. *laticollis* Lec. (L).

Eleodes consobrina Lec. (L).

**Eleodes scabripennis* Lec. (L).

Eleodes scabrosa Esch. (L).

**Coniontis abdominalis* Lec. (L).

Coniontis integer Csy. (D).

Coniontis viatica Esch. (L).

Coniontis, species dubious.

Blapstinus pulverulentus Mann. (L, D). Common on the hills about the fort.

Blapstinus brevicollis Lec. (L).

Blapstinus, one undetermined species (D).

Notibius puncticollis Lec. (D).

Doliema plana (Fab.) (D).

Coelocnemis obesa Lec. (L).

Tenebrio molitor Linn. (L).

Alaephus pallidus Horn (D).
Cratidus osculans Lec. (L).
Amphidora littoralis Esch. (L).
Helops rugulosus Lec. (L).
**Helops angustus* Lec. (L).
**Ptinus verticalis* Lec. (L).
Xeranobium sp. (D).
Scobicia declivis (Lec.) (L).
Polycaon stouti (Lec.) (L).
Canthon simplex Lec. (L).

Canthon simplex var. *militaris* Horn (D). Very numerous upon the hills about the fort, under fresh cow dung.

Aphodius granarius (Linn.) (D). Very numerous. Found with the preceding.

Aphodius vittatus Say (D).

Aphodius lividus (Oliv.) (D). Numerous, especially at light.

Aphodius rudibus Lec. (D). An occasional specimen taken in flight in the early spring.

Rhyssemus californicus Horn (D). Taken in flight on warm days in spring.

Pleocoma fimbriata Lec. (L). Fragments were found in the stomach of a woodpecker.

Serica fimbriata Lec. (L).

Diplotaxis near *insignis* Lec. (D). One specimen at light in June.

Hoplia callipyge Lec. (L).

Hoplia pubicollis Lec. (D). Beaten from willow along the creek.

Ochrosidia longula (Lec.) (D). At light.
Criocephalus asperatus Lec. (D).
**Brothylus gemmulatus* Lec. (L).
**Aneflomorpha lineare* (Lec.) (L).
**Stenocorus nubifer* Lec. (L).

Toxotus vestitus Hald. (D). Taken upon Lupine flowers. Two specimens.

**Leptacmeops falsa* (Lec.) (L).
**Judolia sexspilota* (Lec.) (L).
Strophiona laeta (Lec.) (L).
**Phymatodes blandus* Lec. (L).
**Phymatodes obscurus* Lec. (L).
Xylotrechus nauticus (Mann). (L).

Oxoplus jocosus Horn (D). Found not too commonly upon the flowers of a composit.

Pogonocherus pilatei Van Dyke. Taken by Pilate, Van Dyke and Martin on *Fremontia* near the fort.

**Tetraopes mancus* Lec. (L).

Tetraopes femoratus Lec. (D). On milkweed about the fort. Not common.

Lema trivittata Say var. *nigriventris* Fall (D). Common on *Datura*.

Saxinis saucia Lec. (L, D). Taken not rarely in flight, in summer.

Exema conspersa (Mann.) (L, D).

Pachybrachys livens Lec. (D). Beaten from willow along the creek.

Cryptocephalus spurcus Lec. (D). Beaten from *Compositae* along with *Exema.*

Diachus auratus (Fab.) (L).

**Glyptoscelis albida* Lec. (L).

Colaspidea smaragdula (Lec.) (L).

Colaspidea varicolor Cr. (D). Beaten from greasewood on the hill back of the fort.

Chrysochus cobaltinus Lec. (L).

Gastroidea cyanea Melsh. (D).

Trirhabda luteocincta (Lec.) (L).

Monoxia consputa (Lec.) (L).

Monoxia, one undescribed species (D).

Diabrotica duodecimpunctata (Fab.) (L). This was probably *D. soror,* which was not yet described at the time that Leconte's list was published.

Diabrotica soror Lec. (D).

**Phyllobrotica viridipennis* Lec. (L).

**Scelolyperus flavicollis* (Lec.) (L).

**Luperodes bivittatus* Lec. (L).

**Oedionychis violascens* Lec. (L).

Haltica torquata Lec. (D). A few specimens were taken upon a species of primrose along Grapevine Creek.

Chaetocnema ectypa Horn (D).

Longitarsus livens Lec (D).

Glyptina cerina (Lec.) (D).

Phyllotreta prasina Chittn. (D).

Phyllotreta albionica (Lec.) (D).

The foregoing two species were beaten from oak about the fort.

Psylliodes punctulata Melsh. (D).

**Microrhopala rubrolineata* (Mann) var. *signaticollis* (Lec.) (L.)

Mylabris uniformis Lec. (L).

Mylabris pauperculus Lec. (L, D). Taken in small numbers from the flowers of wild buckwheat.

Rhynchites bicolor Fab. (L).

Apion porosicolle Gemm. (D). One specimen beaten from cottonwood.

Eupagoderes geminatus Horn (D). Rare beneath cow chips on the flats below the fort.

Pandeleteius submetallicus Schffr. (D). Beaten from *Juniperus* on the hill back of the fort. I believe that this species has not hitherto been reported from California.

Sitona californica Fahr. (L).

Desmoris constrictus (Say) (D). Taken upon *Datura.*

Tychius prolixus Csy. (D). Taken from "loco-weed" (*Astragalus* sp.)

Otidocephalus arizonicus Schffr. (D). Beaten in small numbers from mistletoe on the oaks about the fort.

Cionistes insolens Dietz (D).

Dinocleus albovestitus Csy. (D).

Cleonus modestus Mann. (L).

**Aulobaris nasuta* (Lec.) (L).

**Geraeus lineellus* Lec. (L).

Limnobaris nasuta (Lec.) (L).

**Sphenophorus simplex* Lec. (L).

Sphenophorus subcarinatus Mann. (L).

In Leconte's list of 1859, as I have stated, there are 147 species recorded. The present list, including these, numbers 272 species, an addition of 125 species known to come from the immediate vicinity of the fort. In addition to this, there are in my collection 16 or more species doubtful, or undescribed, and a mass of unidentified material. A rather striking thing one notices in going over the present list is the comparatively small number of species recorded by Leconte that have been retaken in later years, and the rather large number of species that are now rather common about the fort that were not taken by either Xantus or Leconte.

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THE METAMORPHOSES OF SIX CALIFORNIA LEPIDOPTERA

By John A. Comstock and Charles M. Dammers

Mitoura nelsoni Bdv.

This species occurs commonly in the higher regions of the California Sierras and is found sparingly in the mountains of southern California. It is abundant on the crest of the Greenhorn Mountains of Kern County during early July.

Females were secured in that locality and were induced to lay in captivity. Twigs of spruce and incense cedar were placed in the cage and the latter plant was chosen for oviposition although the majority of eggs were laid on the netting covering the jar in which the specimens were placed.

The above two plants were selected on account of the fact that the species was found in association with them, but no actual oviposition in nature was observed. Females were noted on many occasions resting in and alighting on the incense cedar (*Libocedrus decurrens* Torr) and that is believed to be the plant of choice.

Larvae were raised to maturity on *Thuja* (arbor-vitae) which is widely cultivated in gardens and parks.

The early stages of this insect so nearly resemble those of *Mitoura siva juniperaria* Comst. and *Mitoura loki* Skin. as to be practically indistinguishable from them, and the following descriptions are therefore somewhat abbreviated in order to avoid repetition.

egg. Diameter averaging about .8 mm. An example deposited July 6, 1932, emerged July 11.

Color, green, of about the same shade as the cedar twigs. They are covered with minute stellate points of a lighter shade, from which low partitions radiate to join those from neighboring points. Form, echinoid. Micropyle deeply depressed.

The stellate points above referred to are slightly less pronounced than in the egg of *juniperaria*, and do not show quite the same degree of alignment. See Plate 24, fig. *a*.

larva, first instar. Length averaging about 1 mm.

Color yellowish, with a slight greenish tinge in the center.

Head a darker yellow, with mouth parts laved with orange. Ocelli black.

There are four rows of long curving colorless or brownish hairs, arranged longitudinally on each side of the median line. These arise from inconspicuous papillae. The sub-stigmatal fold is slightly mottled with brown.

Stigmata, oval, with a brownish ring.

The larva assumes a darker color as it develops until it has attained a dark blotchy green prior to casting its skin. From that point on it is a vivid green, with a sub-dorsal light green band, and a lateral whitish sub-stigmatal line. It is covered with brownish pile of medium length.

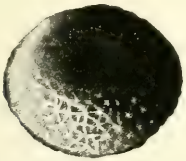
Mature larva. Length 16 mm. Slug shaped, the head deeply retractile. The notes on larva of *M. loki,* published in Vol. XXXI, part 2 of the Bulletin Southern Calif. Academy of Sciences are equally applicable to this species in its mature phase. Plate 24, fig. *b.* illustrates the full grown larva.

PUPA. Length, 9 to 10 mm. Greatest width in mid-dorsal region, 4.5 mm. This stage is indistinguishable in every detail from the pupa of *loki,* which was illustrated in the Bulletin above referred to.

Color, blackish brown of perhaps a slightly darker shade than *loki,* and covered with the same type of brown pile.

Pupation of the particular specimen under observation occurred on August 20. No silk girdle was noted, the chrysalis being formed on the floor of the breeding cage.

From the same group of eggs, reared independently, caterpillars emerged July 12, reached their third instar July 23 and pupated the 18th to 21st of August. The winter is spent in the pupal stage.

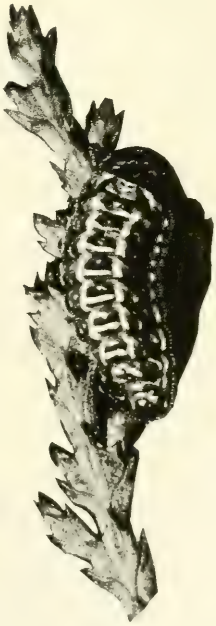


a.

PLATE 24

a. Egg of *Mitoura nelsoni* magnified x 26.

b. Larva of *Mitoura nelsoni* on a sprig of *Thuja* enlarged 2.5 diameters.



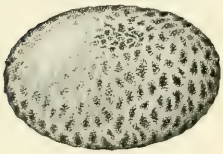
b.

PHILOTES SPECIOSA Hy. Edw.

This rare little blue occurs on the Mojave Desert in localities where its foodplant, *Oxytheca perfoliata* T. and G. is abundant. It has been taken plentifully on the Randsburg road about 20 miles east of the town of Mojave during the months of April and May. Captures are also recorded for the upper Mint Canyon region, the lower Mojave near Victorville, and the "Box S" Ranch, San Bernardino County.

The egg was described in the Jan.-April, 1930, number of the Bulletin Southern Calif. Academy of Sciences, Vol. XXIX, No. 1. The illustration there used is repeated on the accompanying Plate 25, fig. *a*.

It is only necessary to add to the notes already published that the eggs are laid singly on the food plant, and hatch in 8 days.



a.

b.

PLATE 25

a. Egg of *Philotes speciosa* Hy *Edw.* magnified x 56.

b. Larva of same, enlarged x 6.

The plant of choice is *Oxytheca perfoliata,* but as it is practically impossible to keep this fresh even with careful transplanting, a substitute was required to bring the larvae through to maturity. This was found in *Chorizanthe californica* Gray. With both plants it was noted that the caterpillar fed only on the small fleshy points which arise from the stem around the leaf junctures. When at rest the larva curls around the stem at the site of feeding, and in this situation it is difficult to distinguish on account of its protective coloration.

The young larva possesses a ground color of yellowish green, with a variable amount of rose. There is usually a mid-dorsal line of this rose or brownish rose color, and frequently a yellowish lateral line. A few examples show almost a solid rose or mauve, while others have the mid-dorsal line slightly shaded laterally with yellow. In all stages of growth there is wide variation in the color pattern.

Head, black, and retractile.

As the larvae mature they tend to lose the rosy shade, and assume a darker green. A certain percentage are almost a solid green.

Mature larva. Length, when fully extended, 10 to 12 mm.

The form is of the usual slug shape, though slightly narrower than with most

of the blues. Ground color, apple green, covered with short white pile.

The majority of specimens have a mauve or rose colored mid-dorsal narrow band, expanding near the posterior edge of each segment. This band is absent on the first segment. The caudal segments are slightly tinged with a rosy suffusion.

The sub-stigmatal fold is yellow, edged above and below with rose.

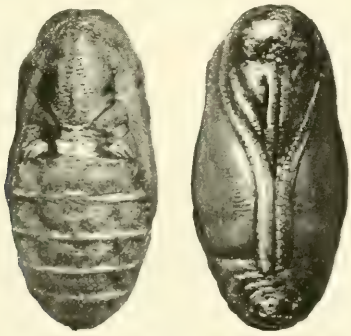
Abdomen, yellow-green. Legs, yellow-green, tipped with brown. Prolegs and anal prolegs, yellow-green with gray claspers. Stigmata, white.

Head, brownish, with a colorless front and a black spot on each side. There is great variation in the color of larvae, as noted for the earlier stages.

Pupation occurs in a loose web on the soil, and the pupa overwinters.

The mature larva is illustrated on Plate 25, fig. *b*.

PUPA. Length 3.75 to 4 mm. Color, a light chestnut. The pupa is stout and compact, with a markedly rugose surface, and shows no vestige of pilose covering. When newly formed, the wing cases, thorax and head are tinged with green, but later change to a dark brown, shading to a blackish brown at the caudal end. See Plate 26.



a. *b.*

PLATE 26.

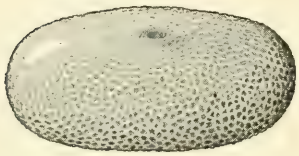
Pupa of *Philotes speciosa*, enlarged x 10.
a. Dorsal aspect. *b*. Ventral aspect.

PLEBEJUS EMIGDIONIS Grin.

The egg of this species was illustrated and described in the Bulletin Southern Calif. Academy of Sciences, Vol. XXIX, Part 1, 1930, p. 23. We are reprinting this illustration on Plate 27, fig. *a*.

Eggs were collected on May 1 of this year, and larvae emerged May 11. Again on May 15 eggs were laid which hatched on the 23rd. A third group of eggs which were deposited July 17 emerged on the 26th. The duration in ovum therefore is from 8 to 10 days. The female deposits her eggs singly on the leaves of *Atriplex* (Saltbush).

LARVA, first instar. Color, bluish green. The usual four rows of long white slightly recurved hairs occur, in longitudinal arrangement. There is a sub-dorsal line of black dots, one to each segment. A similar line also is placed immediately superior to the lateral row of hairs.



a.

b.

PLATE 27

a. Egg of *Plebejus emigdionis* Grin. magnified x 45.

b. Mature larva of same enlarged x 4.

Head black.

In successive instars the color is variable, with the predominant type a pale blue-gray, and the surface is covered with a whitish pile. There is a mid-dorsal band of speckled light brown, and a similarly colored though less clearly defined lateral band in which the spots run diagonally across each segment. The first and caudal segments are speckled with black. On the 11th segment there is a laterally placed retractile organ which, when fully protruded, bears a series of orange points in stellate arrangement on the tip. The illustration, Plate 27, fig. *b*, shows this organ in full extension.

Abdomen, pale gray-green. Legs, pale blue-gray, with brown tips. Prolegs concolorous with abdomen. Spiracles black.

Head black, and retractile.

Mature larva. Length when fully extended, 13 to 15 mm. Slug shaped. The color is extremely variable and ranges from a greenish through blue-green and gray, to a

brown. All examples are spotted and blotched with darker points. The green type may be described as follows.

Body pale bluish green, sparingly speckled with black. The crest of each segmental protrusion is pale mauve. The entire surface is heavily studded with minute silvery white points, from which arise single short white vibrissae. The sub-stigmatal fold is laved with mauve. There is a dark mid-dorsal line.

The caudal segment bears a number of long colorless hairs, and the first segment has a fringe of recurved colorless hairs overhanging the head. The upper part of these two segments is heavily sprinkled with black.

The retractile glands on the 11th segment are large and prominent. They are protruded when the larva is touched. These organs are probably attractive to ants, but we have not observed their use by the latter. There is a valve-like spot on the tenth segment in the mid-dorsal line.

Abdomen concolorous with dorsum but lacking the black dots.

Legs, light brown. Prolegs and anal prolegs concolorous with body, the claspers brown. Spiracles black, with a group of black points inferior to them.

Head, jet black.

Pupation took place on the 15th to 17th of July for those examples which emerged from the egg on May 11th. A few of the larvae hibernated for a portion of their time, but fed intermittently until October and then ceased feeding and went into complete hibernation. Two imagos emerged July 27, which argues for an abortive second brood.

PUPA. Length 9.5 to 11.5 mm. Color, pale green, the body slightly darker. One example was a straw color with lighter wing cases.

a. *b.* *c.*

PLATE 28

Pupa of *Plebejus emigdionis* enlarged x 4.
a. Dorsal aspect. *b.* Lateral aspect. *c.* Ventral aspect.

The form is somewhat more elongate than in the average Lycaenid pupa, and the abdomen is strongly arched.

The segmental junctures are marked by narrow indistinct brown lines. A thin mid-dorsal green stripe runs longitudinally on the first three abdominal segments. Spiracles brown.

The pupa is illustrated on Plate 28, figs. *a, b* and *c*. It is usually attached to the food plant by a silk button and girdle.

ERYNNIS PERSIUS AFRANIUS Lint.

A quantity of eggs and larvae of this species were collected on *Lotus americanus* (Nutt.) Bisch. (Spanish clover) at Forest Home, San Bernardino Mts., between the 6th and 16th of July, 1930. Eggs were also collected at Pine Flats, upper San Gabriel Canyon, on June 28, 1931, where females were ovipositing on *Ceanothus divaricatus*. A drawing was made from one of the latter which is shown on Plate 29.

EGG. Size .75 mm. high by about the same broad. Color when first laid, white, changing to a cream or light yellow. The eggs are deposited on the tender tips of the leaves.

The surface of the egg is covered by a series of about 15 vertical ribs, some of which terminate or join others as they approach the micropyle. A series of regular narrow low horizontal ridges cross the spaces between the vertical ribs.

Micropyle, depressed but shallow. Base, flat.

Duration in the ovum, 5 days for the single example which was under observation.

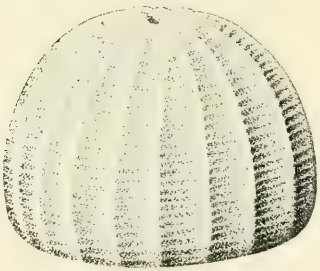


PLATE 29

Egg of *Erynnis persius afranius* Lint. magnified x 50.

Drawing by Comstock.

LARVA, first instar.

Body, ivory white. A few short colorless hairs occur in longitudinal rows on the surface. The first segment bears a black collar at its posterior edge.

Head, jet black, with a few short white hairs protruding.

Mature larva. Length 21 mm.

The body is sub-cylindrical, thickest at about the 6th segment and tapering regularly toward both ends. The head is relatively large, sub-triangular, and is depressed antero-posteriorly. See Plate 30.

The ground color of the body is a pale green, and a thick studding of minute raised white points gives it a light overcast. From these points arise single short white hairs.

A dark mid-dorsal narrow line is present, and there is also a narrow longitudinal yellow line running the entire length of the lateral surface. The first segment bears the usual black collar. The sub-stigmatal fold is slightly lighter than the general body surface.

Abdomen, pale green. Legs and prolegs, green. Spiracles, white.

The head is black, with a covering of minute white punctae. The face bears, on its flattened anterior surface, an orange cordate spot, with black shield-shaped center. The mature larva is illustrated on Plate 30.

Pupation occurs in a loosely spun cocoon or hibernaculum on the food plant. The larvae from which these notes were made went into chrysalis from the 27th of July to August 5.

PUPA. Length, 14 to 15 mm. The illustration, Plate 30, obviates a lengthy description. Color, a vivid green, with the segmental junctures dimly defined in a darker shade of green.

The thoracic spiracle is black, and prominent.

Emergence of the imagos occurred from the 5th to the 15th of August. The species is heavily parasitized with a Tachinid fly.

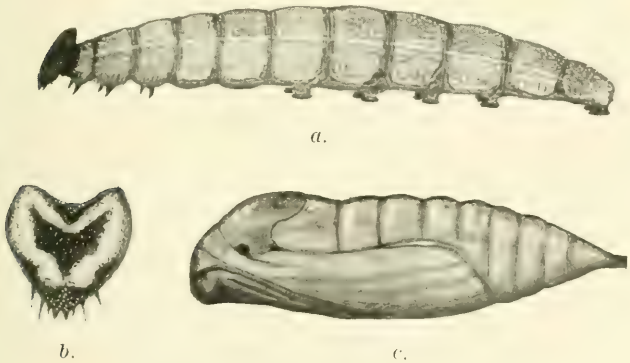


PLATE 30

Larva and pupa of *Erynnis persius afranius*.

a. Mature larva, lateral view, x 3.

b. Head of larva greatly magnified.

c. Pupa, lateral view, x 3.

Drawing by Dammers.

PHOLISORA LIBYA Scud.

EGG. Size 1.1 mm. wide by .8 mm. high. Color, when first laid, dull orange, changing to a soiled ivory white. Shape, hemispherical, the base flat and micropyle depressed.

The surface of the egg is thrown into a number of ridges which radiate from the micropyle. These number about 8 or 9 on the superior surface, and are increased to approximately 18 on the lateral surface. They are widened and protruded on their crests into a number of papillae or knob-like processes. The area between these vertical ridges is bridged by low transverse partitions. The latter are irregular in size and height, and run at various angles, but a considerable number of them tend to radiate from the knob-like processes previously mentioned, giving the latter a stellate appearance. See Plate 31.

Oviposition occurs on the leaves of *Atriplex canescens* James., and probably others of the same genus, the eggs being laid singly.

Described and figured from a single egg collected at Indian Wells, Coachella Valley on October 5, 1930. On the 8th of the same month 15 eggs were obtained from which one larva was raised to maturity.

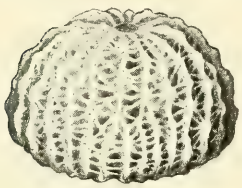


PLATE 31

Egg of *Pholisora libya*, magnified x 25.

Drawing by Comstock.

LARVA, first instar. Length 1.75 mm.

The caterpillar is cylindrical, with a cream colored or pale yellow body which is bare of ornamentation or appendages. A white collar occurs on the first segment, edged anteriorly with black. In successive instars the larva resembles the mature phase.

Mature larva. Length, fully extended, 13.5 mm. Widest at the 6th segment, tapering gradually toward the head, and more acutely toward the caudal end. The body is pale blue-green and is profusely covered with white raised points, from each of which arises a short single white hair. There is a line of black dots running longitudinally on each side of the median line, one dot to each segment. A similar line occurs dorso-laterally, and a third is placed supra-stigmatally, the last mentioned being formed in pairs.

A thin dark indistinct line is placed mid-dorsally. The first segment bears a broad transverse white collar which is edged anteriorly by a black line.

Abdomen concolorous with body. Legs, pale blue-green, the terminal joints tipped with brown. Prolegs and anal prolegs concolorous with body and bearing light brown claspers.

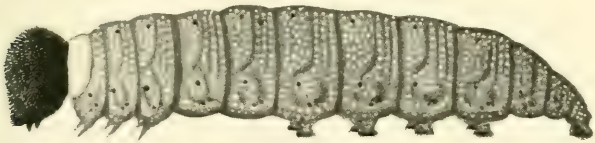
Spiracles, yellow.

Head, black, covered profusely with orange pile. A lateral view of the larva is shown on Plate 32.

The larva secretes itself in a protective nest formed of leaves, united with strands of silk, from which it emerges only at times of feeding.

PUPA. Length, 12:5 mm. Sub-cylindrical, the head rather prominent, thorax slightly arched dorsally, and the caudal segments recurved ventrally.

The head and body are pale ochre to light brown. Abdominal segments, brown, lighter on their posterior edges. Wing cases, and thorax, black. Above the eye cases and over the anterior portion of the head there are tufts of light chestnut pile.



a.

b.

PLATE 32

Larva and pupa of *Pholisora libya*, enlarged.

a. Larva, lateral view x 6. *b.* Pupa, lateral view x 5.

Drawing by Dammers.

The thorax and most of the abdomen is similarly covered.

Caudal segments and cremaster, black.

The pupa is illustrated on Plate 32.

Pupation occurs within the protective nest.

This species is double brooded on the Colorado Desert. It ranges throughout the Colorado Desert and the Palo Verde Valley in locations where *Atriplex* grows, and has been taken sparingly as far north as Round Valley, Inyo County.

EUCATERVA VARIARIA Grote.

Larvae and pupae of this species were collected in the Morongo wash, San Bernardino County, and Mr. E. Jaeger also found them at Amboy on the Mojave Desert. They have been bred in captivity through three generations, the imagos emerging in May, July and September of the same year.

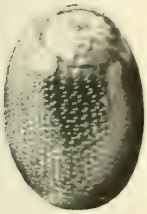
The eggs are laid in a mass on the foliage of Desert willow, *Chilopsis linearis* Sweet.

EGG. Barrel-shaped, about 1½ times as long as it is broad. Color, pale blue-green, with a metallic or pearly luster. The surface is covered with minute raised white points which are arranged in longitudinal, though somewhat irregular rows. Under magnification the surface is finely granular. The ends are flattened, and the micropylar end is slightly depressed at its outer circumference. See Plate 33, fig. *a*.

In the early instars the larva is very similar to the mature stage.

Final instar. Length, 32 mm. Cylindrical and elongate, of the usuad geometrid type. There are two color forms, one with a mauve on the dorsal half, and one with a blue-green dorsum. Intergrades occur. The mauve type will be described.

Dorsal surface, pale mauve, similar in shade to the blossoms of the food plant. There is a sub-dorsal band of two thin black crenulate lines extending the entire length of the body. Inferior to this the body shades to a pale blue, and thence to a bluish green on the abdomen. Immediately below the sub-stigmatal fold there is a thin black crenulate line across the center of each segment.



a.

b.

PLATE 33

Egg and larva of *Eucaterva variaria.*

a. Egg, greatly magnified.

b. Mature larva, enlarged x 2.

On the 2nd and 3rd segments, in line with the stigmata, there is a small black triangle.

Each segment bears six small black dots on each side, arranged in diagonal pairs, from which arise short colorless hairs. The last three segments are a yellowish green.

Stigmata, black, surrounded by a yellow area, the latter not apparent in all specimens.

Legs, orange, crossed by several narrow black lines. The terminal joints are tipped with black. Prolegs, and anal prolegs, pale green, spotted with black. Claspers, orange.

Head, pale mauve, speckled black, and bearing a sparse covering of short colorless hairs.

Pupation occurs on the food plant, in a loosely and characteristically meshed cocoon, as shown on Plate 34. The pupa is visible through this mesh.

PUPA. Length, 16 to 18 mm. Robust, with prominently protruding antennal and leg cases. Thickest through the 4th abdominal segment.

Wing cases, thorax and head, pearly white. Body a pale yellow-green, with dark brownish spots irregularly placed and indistinct.

The black markings of the imago are dimly visible or at least suggested through the wing cases. Ocellar ribbon, orange.

Stigmata, depressed. The pupa is illustrated on Plate 35.

As the Desert willow is a deciduous tree, and the cocoons of the last brood must fall to the ground, it is still doubtful how the winter is passed. A considerable number are, however, known to pass the winter in the cocoon.

The larva of this species is so remarkably camouflaged as to make it exceedingly difficult to find. Even when it is beaten from the tree it can not be detected among the fallen leaves until it moves.

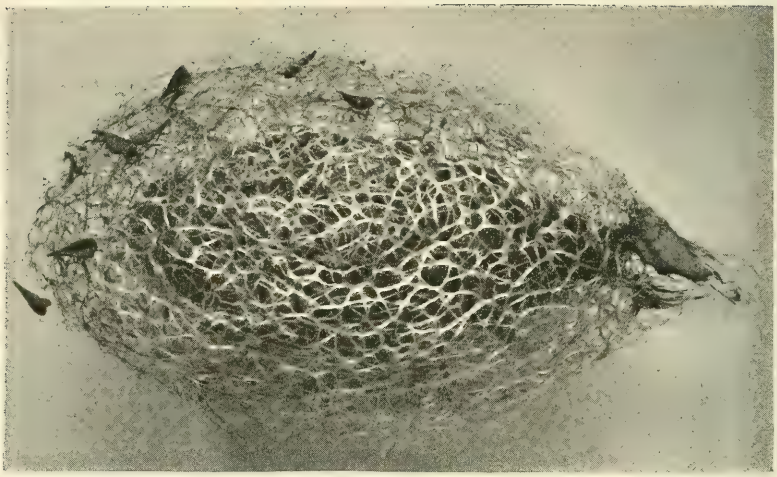
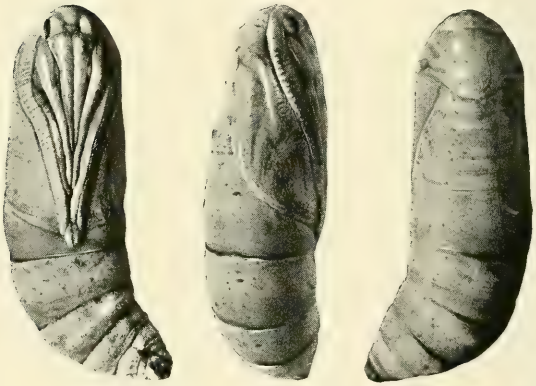


PLATE 34

Cocoon of *Eucaterva variaria*, enlarged x 2.



a. *b.* *c.*

PLATE 35

Pupa of *Eucaterva variaria*, enlarged x 3.

a. Ventral aspect. *b.* Lateral aspect.

c. Dorsal aspect.

NOTES ON THE FLORA OF THE CHANNEL ISLANDS OFF SANTA BARBARA, CALIFORNIA

II.

By Ralph Hoffmann*

Delphinium parryi Gray.

Frequent on a steep grassy bank above Cuylers Harbor, San Miguel I.

Ranunculus californicus Benth.

Plants from Santa Rosa and San Miguel Is. (and west end of Santa Cruz I.) are "unusually low and hairy" and resemble var. *Ludovicianus* (Greene) Davis. S. B. M. No. 6228.

Since the above was written, Mr. Lyman Benson has identified the following as *Ranunculus californicus cuneatus* Greene: northeast end of San Miguel I., Hoffmann on April 20, 1932; above Cuyler's Harbor, San Miguel I., Hoffmann on April 19, 1932; and Santa Cruz I., mouth of Willow Creek, Hoffmann on March 21, 1932; Prisoner's Harbor, Hoffmann on March 5, 1932.

Clematis lasiantha Nutt.

Frequent on steep brushy banks in Laguna Canyon and occasional on the Puertazuela Grade, on Santa Cruz I.

Berberis pinnata Lag.

A colony below the Cuesta Grade, at the west end of Santa Cruz I., with stems to nineteen feet long, climbing through *Quercus tomentella* and *Photinia*, with leaves often entire, S. B. M. Nos. 11,781 and 11,162; a few plants in a canyon running into the Cañada de la Casa on Santa Rosa I.

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*The first part of this paper appeared in the Bulletin of the Southern California Acad. Sci. 31: 46-60, 1932. Since that part was written, Mr. Hoffmann met a sudden tragic death. It has been my privilege to assemble for publication the rest of Mr. Hoffmann's notes and I have been most happy to do my part in presenting this material, for two reasons: firstly, as an offering of affection for one whom I admired and whose friendship I greatly prized; secondly, as a contribution to botanical science. It has seemed to me very fortunate for California Botany that Mr. Hoffmann had left his notes in such form that the paper could be continued. His years of work on the islands have added tremendously to our knowledge of their flora and I have long anticipated a thorough-going discussion of that flora by him, who knew it so well, in which he would point out the significance of the distribution of many of the species mentioned in this paper. The occurrence, particularly on San Miguel and Santa Rosa Islands, of many species whose southern limit had been thought to be Monterey and San Luis Obispo Counties, is to me one of the most interesting things that have come from Mr. Hoffmann's work. The present preliminary paper was only to record data which would later receive interpretation. It has been my function, of course, in so far as I have been able, not to intrude ideas of my own but to act as an editor or clerk in assembling the ideas that Mr. Hoffmann had left on record. The more elaborate work which Mr. Hoffmann had proposed for the future must now unfortunately be taken up by some subsequent student, but at least we have now this very useful list of additions to and notes on the plants of the islands. It should of course be said that I assume full responsibility for all errors that may have crept into my part of the work. Philip A. Munz, Pomona College, Claremont, California.

PLATYSTEMON CALIFORNICUS Benth.

Although *P. californicus* var. *nutans* was described by Brandegee from Santa Cruz I., most, if not all of the material collected by the writer from that island, has erect fruit. Several collections have the fruit with long stiff hairs, S. B. M. No. 2854. On Santa Rosa and San Miguel Is. the common form on sandy slopes near the sea is low and spreading, glabrous or nearly so, with very white flowers and nodding fruit.

PAPAVER CALIFORNICUM Gray.

On steep banks from Orizaba Harbor to Pelican Bay, Santa Cruz I.*

PAPAVER HETEROPHYLLUM (Benth.) Greene.

Occasional on steep banks on Santa Rosa I. and frequent on San Miguel I.

ESCHSCHOLTZIA ELEGANS Greene.

Brandegee includes under *E. californica* Cham., the above species including *E. glauca, E. maritima, E. elegans* and *E. ramosa* of Greene. *E. elegans* is a very clearly marked species, an annual, with stiff, erect habit, finely dissected glaucous, often purplish-tipped foliage and petals from 5-7 mm. long. It is frequent on steep canyon banks, generally near the sea, on the south side of Santa Cruz I. and on Santa Rosa I. S. B. M. Nos. 11,151 and 12,114.

ESCHSCHOLTZIA CALIFORNICA Cham. var. MARITIMA Greene.

Occasional on Santa Cruz I., common on mesas and sandy slopes near the sea along the north shore of Santa Rosa I. and widely distributed on San Miguel I.

ESCHSCHOLTZIA GLAUCA Greene.

Whatever disposition is finally made of this form, it is still growing in a restricted area where Greene probably found it, between the Main Ranch on Santa Cruz I. and the South Ranch House. S. B. M. No. 10,440.

ESCHSCHOLTZIA SP.

Besides the perennial species listed above and the annual *E. elegans,* there occurs on steep rocky slopes on Santa Cruz I. an annual erect species with showy, clear yellow flowers. S. B. M. No. 12,039.

THELYPODIUM LASIOPHYLLUM (H. & A.) Greene.

As this species occurs on the islands it is exceedingly variable. What is apparently the common form of the species (more or less hispid with scattered hairs, flowers whitish, fruit slender and deflexed) occurs on San Miguel I., S. B. M. Nos. 9607, 9438;

* (Clokey).

Santa Rosa I., S. B. M. No. 1219; and Santa Cruz I., S. B. M. Nos. 1221 and 4756. A glabrous form with deflexed pods occurs on Santa Cruz I., S. B. M. Nos. 1220 and 2677; Santa Rosa I., S. B. M. No. 6202; and San Miguel I., S. B. M. No. 1218. A form with purplish petals was found on Santa Rosa I., S. B. M. No. 6201. A glabrous form with somewhat spreading pods occurs on Anacapa I., S. B. M. No. 5538; it fits quite well the description of var. *rigidum* Robins., although the pods are slender. Another plant from Anacapa has the pods ascending and fits the var. *inalienum* Robins. S. B. M. No. 5535.

SISYMBRIUM PINNATUM (Walt.) Greene.

Occasional on Santa Rosa I.

CAKILE EDENTULA (Bigel.) Hook. var. CALIFORNICA Fer.

Occasional on beaches on Santa Rosa and San Miguel Is.

RAPHANUS SATIVUS L.

Occasional in fields near ranches on Santa Cruz and Santa Rosa Is.

CARDAMINE OLIGOSPERMA Nutt.

One collection on Santa Cruz I. S. B. M. No. 241.

DENTARIA INTEGRIFOLIA Nutt. var. CALIFORNICA Jepson.

Occasional on the north side of slopes above the sea on San Miguel I.

ARABIS MAXIMA Greene var. HOFFMANNII Munz (Bull. So. Calif. Acad. Sci. 31: 63. 1932).

On a sea cliff, east of Dicks Harbor, Santa Cruz I., S. B. M. Nos. 11,750, 11,838. An Arabis collected only in fruit in Water Canyon, on Santa Rosa I. is presumably this variety. S. B. M. No. 10,893.

ERYSIMUM ASPERUM (Nutt.) DC.

What seems to be this species is found on Anacapa and Santa Rosa Is., S. B. M. Nos. 4151 and 141.

DITHYRAEA CALIFORNICA Harv. var. MARITIMA Dav.

Occasional on the north beach of San Miguel I. First collected by F. R. Fosberg. S. B. M. No. 9583.

LEPIDIUM DICTYOTUM Gray var. ACUTIDENS Gray.

Locally abundant at the west end of Santa Cruz I.

LEPIDIUM DRABA L.

Several flourishing patches in grassy fields south of the Main Ranch on Santa Cruz I.

LEPIDIUM LASIOCARPUM Nutt.

Common in thin soil on Santa Cruz I.

LEPIDIUM NITIDUM Nutt.

Omitted from Brandegee's list for Santa Cruz I., though listed by Greene. Common in thin soil on Santa Cruz and Santa Rosa Is.

CAPSELLA BURSA-PASTORIS L.

Frequent on Santa Rosa I. and occasional on San Miguel I.

THYSANOCARPUS CONCHULIFERUS Greene.

Reduced by Jepson to a variety of *T. laciniatus* Nutt. A large series collected by the writer shows, in the opinion of both Drs. Abrams and Munz that *T. conchuliferus* is a good species. Besides its boat-shaped fruit, its differs from *T. laciniatus* in its glaucous foliage, its rose-colored flowers and its lesser height, characters which appear to be constant. The species is frequent on exposed rocky slopes on Santa Cruz I. from the north shore (Prisoners, Pelican, Babys) to the south west portion of the island (Sierra Blanca).

THYSANOCARPUS CURVIPES Hook.

One collection on a steep open slope above Upper Twin Canyon, Santa Cruz I. S. B. M. No. 11,866. Det. by P. A. Munz.

THELYPOLIUM LACINIATUS Nutt. var. RAMOSUS (Greene) Munz.

The plants of Santa Rosa and Santa Cruz Is. differ from typical *T. laciniatus* in their larger fruits, these being 4 or more mm. wide (including the wings). Common on Santa Cruz and Santa Rosa Is. Apparently *T. laciniatus* of Brandegee's list and var. *emarginatus* of Clokey's.

TILLAEA ERECTA H. & A.

Occasional on shaded banks, San Miguel I.

COTYLEDON Sp.

Material from the islands is exceedingly variable and can only with great artificiality be divided into species. Rose's treatment (No. Amer. Flora 22:33-47, 1905), which divided the group into species on the basis of slender or short and stout pedicels, green or farinose leaves, narrow or broader leaves, etc., seems to fail quite completely with a series of island plants. Plants from shaded places seem to be greener; those from sunny ones more farinose. Leaf-width and-length, pedicel-length, and other characteristics do not seem to vary together. Yet the insular plants seem quite different in the sum--total of their characters from mainland plants, at least those of Southern California.

JEPSONIA MALVAEFOLIA (Greene) Small.

Very little material of this species had been collected on the islands since the original collections by Kellogg in 1874. Jepson (Manual p. 457) included it in *J. parryi* (Torr.). It has been found to be common on bare slopes and canyon banks on Santa

Rosa I. and widely distributed on Santa Cruz I. The series collected seems to show that it is distinct from *J. parryi*. S. B. M. No. 10,796 (Santa Cruz) and Nos. 9196, 10,929, 10,932 (Santa Rosa).

LITHOPHRAGMA CYMBALARIA T. & G.

Common on shaded banks on Santa Rosa I.

HEUCHERA MAXIMA Greene.

Brandegee referred the Heuchera from the islands to *H. pilosissima* F. & M. Munz believes *H. maxima* to be a good species. It occurs on Anacapa I. as well as on Santa Cruz and Santa Rosa Is.

RIBES MALVACEUM Sm.

In the only deep canyon on Anacapa I., below the Cuesta Grade at the west end of Santa Cruz I. and in Tranquillon Canyon on Santa Rosa I. The form is the same on all three islands, with thick white tomentum on the under sides of the leaves.

ALCHEMILLA CUNEIFOLIA Nutt. (*Alchemilla arvensis* (L.) Scop. for Calif. references.)

Frequent on grassy banks on Santa Rosa I.

CERCOCARPUS ALNIFOLIUS Rydb.

Greene listed *C. betulaefolius* Nutt. (*C. betuloides* Nutt.). Brandegee included Greene's material in *C. parvifolius* Nutt. Rydberg (N. Am. Flora 22, part 5, pp. 418-424) gave *C. traskiae* Eastw. and *C. alnifolius* Rydb. from Santa Catalina I. but makes no mention of the islands discussed in this paper. Jepson (Manual, p. 503), makes a new variety, *C. betuloides* Nutt. var. *multiflorus* Jepson from Santa Catalina I. and gives *C. alnifolia* (*alnifolius* ?) Rydb. from Santa Cruz I.

Material collected shows forms that correspond to *C. traskiae* and gradation from these to *C. alnifolius* from Santa Cruz I. S. B. M. No. 11,130.

Plants representative of *C. alnifolius* are Santa Cruz I., S. B. M. Nos. 8676, 8675, 10,315, 8687, 8677.

A few individuals of *C. alnifolius* occur in Tranquillon Canyon on Santa Rosa I.

CERCOCARPUS BETULOIDES Nutt. var. MULTIFLORUS Jepson.

Frequent on canyon slopes on Santa Cruz I. S. B. M. Nos. 202, 199, 201.

C. TRASKIAE Eastw.

Representative of this species from Santa Cruz I. is S. B. M. No. 200; see also under *C. alnifolius* above.

LUPINUS ALBIFRONS Benth.

Brandegee and Greene list *Lupinus chamissonis* Esch. from Santa Cruz, Santa Rosa and San Miguel Is. A large amount of material of shrubby lupines from these islands has been determined by C. P. Smith as *L. albifrons* and its varieties. The type is common on Santa Rosa I. and occasional on Anacapa and San Miguel Is.

L. ALBIFRONS var. EMINENS C. P. Sm.

Occasional on rocky slopes on Santa Cruz I.

L. ALBIFRONS var. DOUGLASII C. P. Sm.

Occasional on Santa Cruz and Santa Rosa Is.

LUPINUS BICOLOR Lindl.

Brandegee lists *L. micranthus* Dougl. from Santa Cruz and Santa Rosa Is. and includes *L. umbellatus* Greene under this species. One collection by the writer from Santa Cruz I. has been determined by C. P. Smith as *L. micranthus*. *L. bicolor* Lindl. is frequent on Santa Cruz and Santa Rosa Is.

L. BICOLOR var. MICROPHYLLUS C. P. Sm.

Occasional on Santa Rosa and San Miguel Is.

L. BICOLOR var. TRIDENTATUS C. P. Sm.

Occasional on Santa Cruz I.

L. BICOLOR var. UMBELLATUS C. P. Sm.

Common on Anacapa, Santa Cruz and Santa Rosa Is.

L. CONCINNUS Agardh. var. AGARDHIANUS (Heller) C. P. Sm.

Frequent on rocky slopes on Santa Cruz I. and occasional on Santa Rosa I.

L. HIRSUTISSIMUS Benth.

Occasional on steep canyon banks, with southern exposure, on Santa Rosa I.

L. SUCCULENTUS Dougl.

This species was listed by Brandegee as *L. affinis* Agardh. It is occasional on grassy slopes and canyon banks on Santa Rosa and San Miguel Is.

L. TRUNCATUS Nutt.

Occasional on rocky slopes on Santa Rosa I.

MEDICAGO APICULATA Willd.

This species is abundant even on rocky slopes on Santa Cruz I.,* much commoner than *M. hispida* on Santa Rosa I. It is occasional along streams.

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* (Clokey).

M. HISPIDA Gaertn.

Abundant on Santa Rosa I.

M. SATIVA L.

Occasionally persistent in fields on Santa Cruz and Santa Rosa Is.

TRIFOLIUM ALBOPURPUREUM T. & G.

Occasional on grassy slopes on Santa Cruz and Santa Rosa Is.

T. AMPLECTENS T. & G. var. STENOPHYLLUM (Nutt.) Jeps.

Common on grassy slopes in thin soil on Santa Rosa I. Collected by B. Norris toward the west end of San Miguel I.

T. BARBIGERUM Torr.

One collection in a moist grassy spot on Santa Rosa and one by B. Norris on San Miguel I.

T. CILIATUM Nutt.

Frequent on grassy slopes on Santa Rosa I.

T. FUCATUM Lindl. var. FLAVULUM Jepson.

Locally common on a slope in the high portion of San Miguel I. S. B. M. No. 11,954.

T. FUCATUM var. GAMBELLII Jepson.

On a bare summit in the interior of Santa Rosa I. S. B. M. No. 12,107.

T. GRACILENTUM T. & G.

Common on grassy slopes on Santa Rosa I.

T. GRACILENTUM var. INCONSPICUUM Fern.

Frequent on Santa Rosa I., occasional on San Miguel I. S. B. M. Nos. 12,154 and 11,928.

T. MACRAEI H. & A.

Frequent on rocky slopes on Santa Cruz and Santa Rosa Is.

T. MICROCEPHALUM Pursh.

Common on banks and slopes on Santa Rosa I. and occasional on San Miguel I.

T. TRIDENTATUM Lindl. var. ACICULARE McD.

Common on grassy slopes and occasional on stony ridges on Santa Cruz I.

T. MICRODON H. & A. var. PILOSUM Eastw.

Plants as pilose as Miss Eastwood's type have been collected on an open gravelly ridge, Pine Forest, at the west end of Santa Cruz I., March 25, 1932.

T. VARIEGATUM Nutt.

Occasional on the flood plain in the Cañada del Puerto, Santa Cruz I.

LOTUS GRANDIFLORUS Benth.

On a rocky slope above Lobo Canyon on Santa Rosa I.

L. HAMATUS Greene.

Occasional on stony slopes on Santa Cruz and Santa Rosa Is. S. B. M. Nos. 5415 and 11,935.

L. SALSUGINOSUS Greene.

Occasional on stony slopes, San Miguel I.

L. SCOPARIUS (Nutt.) Ottley var. VEATCHII (Greene) Ottley.

Material intermediate between *L. scoparius* var. *dendroideus* and var. *veatchii* is found on sea cliffs at the west end of Santa Cruz I. and on steep canyon slopes near the sea on Santa Rosa I.

L. SUBPINNATUS Lag.

Frequent on rocky slopes on Santa Rosa I.

ASTRAGALUS DIDYMOCARPUS H. & A.

Common on hill slopes in thin soil in the interior of Santa Rosa I., occasional on San Miguel I.

A. LEUCOPSIS T. & G. var. BRACHYPUS Greene.

Typical *A. leucopsis* is common on the southwest portion of Santa Cruz I., the variety *brachypus* is the common form on the grassy uplands of Santa Rosa and San Miguel Is.

VICIA AMERICANA Muhl.

Occasional on San Miguel I.

V. CALIFORNICA Greene.

Material from Santa Rosa I. would fall into the above classification, if the specific difference between *V. americana* and *V. californica* is maintained.

V. EXIGUA Nutt.

Occasional on shaded banks on Santa Rosa I.

LATHYRUS STRICTUS Nutt.

Frequent on shaded banks on Santa Rosa I.

OXALIS CORNICULATA L.

A garden weed at the Main Ranch, Santa Cruz I.

GERANIUM CAROLINENSE L.

Occasional on grassy banks on Santa Rosa I.

Erodium botrys Bertol.

Collected by P. A. Munz in the interior of Santa Rosa I.

Erodium moschatum L'Her.

Frequent on Santa Rosa I.

Polygala californica Nutt.

Frequent under pines toward the west end and at one locality south of Pelican Harbor, on Santa Cruz I.

Eremocarpus setigerus Benth.

Collected by I. W. Wiggins near the Ranch on Santa Rosa I.

Rhamnus californica Esch.

A colony of about seven bushes in the upper part of Babys Canyon on Santa Cruz I. The form according to C. B. Wolf, is intermediate between var. *typica* and var. *tomentella.*

Rhamnus crocea Nutt. var. insularis Sarg. (R. pirifolia Greene)

Frequent in canyons toward the southern part of Santa Rosa I.

Ceanothus macrocarpus Nutt.

A single collection from Santa Cruz I.

Malva parviflora L.

Brandegee listed *M. borealis* Wallm. from all the islands. Greene had listed *M. parviflora* L. from Santa Cruz and San Miguel Is. and noted that it was called *M. borealis* on the mainland. All the material collected by the writer on all the islands must be referred to *M. parviflora.*

Oligomeris linifolia (Vahl.) McBr.

Common on bare slopes on the south side of Santa Rosa I. and frequent elsewhere on the island.

Opuntia prolifera Engelm.

Common along the highest part of the ridge on Anacapa I.; one colony at the south-east end of Santa Rosa I.

Echinocystis fabacea Naud.

Brandegee included under the above species, Greene's *E. guadalupensis* and *E. macrocarpa.* The writer has collected at least two species on both Santa Cruz and Santa Rosa Is., one with large white flowers, long spines and from eight to sixteen seeds. This species occurs also on Anacapa and San Miguel Is. Another species, with small greenish-white flowers, short spines and four seeds, is frequent in the Cañada del Medio on Santa Cruz I. and occasional in the interior of Santa Rosa I.

CUCURBITA FOETIDISSIMA HBK.

A few plants on the beach at Fry's Harbor, Santa Cruz I.

EPILOBIUM ADENOCAULON Hausskn.

Water Hole near China Harbor, Santa Cruz I. Det. by P. A. Munz. S. B. M. No. 11,369. Sept. 20, 1930.

GODETIA EPILOBIOIDES Wats.

Common on steep banks, Santa Rosa I. S. B. M. No. 6164.

OENOTHERA CHEIRANTHIFOLIA Hornem. var. TYPICA Munz.

A few plants on beach back of Gull Rock, Santa Cruz I.; common on beaches, bluffs and mesas near the sea, Santa Rosa I.; dunes on San Miguel I.

OENOTHERA CHEIRANTHIFOLIA var. NITIDA (Greene) Jeps.

Occasional on sand dunes at east end of Santa Rosa I.

OENOTHERA CONTORTA Dougl. var. EPILOBIOIDES (Greene) Munz.

San Miguel I.

OENOTHERA CONTORTA Dougl. var. STRIGULOSA (F. & M.) Munz.

Sea-bluffs at East Point, Santa Rosa I., April 9, 1930. S. B. M. Nos. 9383 and 9423.

OENOTHERA MICRANTHA Hornem. var. TYPICA Munz.

On open rocky, gravelly or sandy slopes, Santa Cruz, Santa Rosa and San Miguel Is. Sometimes quite near the var. *jonesii* (Lévl.) Munz.

OENOTHERA LEPTOCARPA Greene (EULOBUS CALIFORNICUS Nutt.).

Occasional on rocky slopes, Santa Rosa I.

SANICULA BIPINNATIFIDA Dougl. var. HOFFMANNII Munz., n. var.

Winged rachis not continuous but extending only part way to the lower divisions of the leaf, hence V-shaped; flowers yellow. (Rachis alata non continua; floribus luteis). Type, from springy bank, Valdez, Santa Cruz I., June 13, 1930, *R. Hoffmann*. (Pomona College Herbarium No. 183,133.) Other collections, under oaks, one mile below Main Ranch, Santa Cruz I., Hoffmann on April 12, 1931 (S. B. M. No. 11,153) and Water Canyon, Santa Rosa I., April 18, 1932, *R. Hoffmann* (S. B. M. Nos. 12,055 and 12,056). This proposed variety has the large heads of *S. bipinnatifida* with sessile fruits; it agrees in its yellow flowers with the var. *nemoralis* Jeps. from the Sierra Nevada, but differs from that variety by the rachis narrowing down to the midrib instead of running the whole length from the upper to the lower leaf-divisions.

Torilis nodosa (L.) Gaertn.

Near Prisoners Harbor, Santa Cruz I.;* on shady bank in canyon northeast of Black Mt., Santa Rosa I.; and along rivulet above Cuylers Harbor, San Miguel I.

Caucalis microcarpa H. & A.

Common on grassy and rocky slopes, Santa Cruz I. at Babys Harbor, a mile below the Main Ranch, and one mile west of Puertazuela.

Apiastrum angustifolium Nutt.

Occasional on rocky slopes in a compact dwarf form, Santa Rosa I.

Bowlesia lobata R. & P.

Frequent in rich soil on shaded banks at Pelican, Orizaba and Babys Harbors of Santa Cruz I.,* and common on canyon banks of Santa Rosa I.

Foeniculum vulgare (L.) Gaertn.

A few plants in a canyon near the ranch house, Santa Rosa I.

Lomatium caruifolium (T. & G.) C. & R.

On San Miguel I. S. B. M. Nos. 9475 and 618.

Arbutus menziesii Pursh.

A single tree, 20 feet tall, at the head of a small canyon west of the ridge leading from Fry's Harbor to the summit, Santa Cruz I. S. B. M. Nos. 11,141 and 11,204.

Arctostaphylos insularis Greene.

Common on steep hillsides and rocky canyon slopes and ridges of Santa Cruz I., and in a side canyon above Water Canyon, Santa Rosa I. The leaves are oblong and rounded to cuneate at the base. A form in which the racemes are elongated and almost glabrous, the sepals being ciliate is determined by Miss Eastwood as a new variety. It occurs at Valdez, Pelican, Christy's and Cochies Harbors on Santa Cruz I., S. B. M. Nos. 2894, 1726, 2436 and 10,792. Between China and Scorpion Harbors, Santa Cruz I., growing on high ridges, occurs another plant with subcordate leaves and the twigs and inflorescence heavily glandular-pubescent. Miss Eastwood has determined it as an undescribed species, S. B. M. Nos. 10,301, 10,798, 10,797. This same form is on Santa Rosa I., S. B. M. Nos. 6251, 10,039, 75, 6199, 9194, 9145, 6037 and 9540.

* (Clokey).

Arctostaphylos tomentosa (Pursh) Lindl.

Represented by plants 3 feet high with branches spreading on the ground, near the pines at the west end of Santa Cruz I. On the same island, on ridges in the pines east of Christy's is a more hispid form which Miss Eastwood has identified as var. *hispida* Hook., S. B. M. No. 5736.

Vaccinium ovatum Pursh.

A few bushes at the heads of canyons on the northeast slope of Black Mt., Santa Rosa I., one reaching the height of 10 feet.

Anagallis arvensis L.

Occasional along streams, Santa Cruz I., and in a meadow northwest of the Ranch, Santa Rosa I.

Centunculus minimus L.

Moist spot in meadow, northwest of the Ranch, Santa Rosa I., S. B. M. No. 12,074.

Statice arctica Blake var. californica Blake.

On open ridges facing the sea, Water Canyon, and west of Torrey Pines, Santa Rosa I., S. B. M. No. 12,090.

Asclepias mexicana Cov.

Frequent along a stream running into Smugglers Harbor, Santa Cruz I., also in upper main valley west of the Main Ranch, and on dry slopes near Mt. Diablo.

Dichondra repens Forst.

On Santa Cruz I., two small colonies on ridge from Laguna Canyon to Sierra Blanca.

Convolvulus soldanella L.

San Miguel I., Ben Norris, S. B. M. No. 9332; beach at west end of Santa Cruz I., S. B. M. No. 326.

Cressa cretica L.

A large patch at mouth of stream at Scorpion Harbor, Santa Cruz I.; locally abundant about salt marsh, east end of Santa Rosa I.

Cuscuta californica Choisy.

Sand dunes at east end of Santa Rosa I., growing on *Franseria* and *Lupinus*. S. B. M. Nos. 9674 and 9181.

Gilia millefoliata F. & M.

Common on grassy slopes on Santa Cruz, Santa Rosa, San Miguel and Anacapa Is.; ranging from form quite near *G. multicaulis* Benth. with rather broadly funnelform corollas to forms near *G. nevinii* Gray with narrower ones. For the most part, the

corollas are narrow, rather dark blue, and 6-9 mm. long. These probably are the *G. nevinii* of Brandegee's list, but that species from Catalina I., has corollas 10-14 mm. long. Det. P. A. Munz.

GILIA TENUIFLORA Benth.

Sandy areas at the end of Santa Rosa I., S. B. M. No. 9432.

NEMOPHILA PARVIFLORA Dougl.

Frequent on shaded banks, Santa Rosa and San Miguel Is. S. B. M. Nos. 5994, 5993, 5992 and 9226.

PHACELIA GRANDIFLORA Benth.

Occasional on steep banks, Santa Rosa I., S. B. M. Nos. 977 and 5989 and on rocky canyon banks, Santa Cruz I., S. B. M. No. 10,105.

PHACELIA INSULARIS Munz. n. sp.

Annual, decumbent, simple or branched from the base, stems 5-15 cm. long, villous; leaves oblong-ovate, 1-2 cm. long, obtuse, entire or the lower ones coarsely few-toothed, on petioles equal to or shorter than the blades; cymes lax, few-flowered, not grandular; pedicles 5-8 mm. long; calyx-lobes oblanceolate, 5-6 mm. long in flower, 8 mm. long and venulose in fruit; corolla open-campanulate, violet, 8 mm. long; scales lance-ovate, free in upper half; stamens included, filaments glandular-puberulent; style pubescent, slightly longer than calyx, divided in upper third; capsule ovoid, 5-6 mm. long, pubescent; seeds foveolate.

Annua, decumbens, simplex vel ramosa, 5-15 cm. alta, villosa; foliis oblongo-ovatis, 1-2 cm. longis, obtusis, integris vel infinis interdum cum dentibus grandibus paucisque; petiolis non longioribus ac laminis; cymis laxis, cum floribus paucis, non-glandulosis; pedicellis 5-8 mm. longis; lobis calycis oblanceolatis, 5-6 mm. longis in floribus, 8 mm. longis et venulosis tardius; corollis lato-campanulatis, violaceis, 8 mm. longis, squamis corallae lanceolato-ovatis, supra liberis; staminibus inclusis; filamentis glanduloso-puberulentis; stylo pubescente, ca. 4 mm. longo; capsulis ovoideis, 5-6 mm. longis, pubescentibus; seminibus foveolatis.

Type, from sand dunes at northeastern part of Santa Rosa I., April 9, 1930, *Munz* 11,756, Pomona College Herbarium, No. 170,966. Other collections are from Santa Rosa I.; S. B. M. Nos. 9400, 9166, and San Miguel I., S. B. M. Nos. 756 and 9439.

This species is near *P. curvipes* Torr. and *P. davidsonii* Gray, but the corolla-scales are more free; the filaments are glandular-puberulent, not bearded; and the calyx-lobes are broader.

HELIOTROPIUM CURASSAVICUM L.

Common on beaches, in stream-beds, and on mesas near the sea, Santa Rosa I.

Amsinckia spectabilis F. & M.

A plant in which the calyces have two of the axial lobes united at least to the middle, and the leaves are usually erose-dentate. Usually prostrate. On Santa Cruz I., on Santa Rosa I. and on San Miguel I, where it is abundant.

Amsinckia spectabilis var. nicolai (Jeps.) Johnston.
(A. St. nicolai Eastw., A. intermedi var. nicolai Jeps.)

Spikes leafy-bracted throughout. On San Miguel I., *Munz and Crow,* 11,789.

Amsinckia intermedia F. & M.

An erect species, with distinct calyx-lobes and entire leaves. On Santa Cruz, Santa Rosa, and San Miguel Is.

Cryptantha micromeres (Gray) Greene. (Krynitzkia micromeres Gray.)

Occasional on shaded banks, Elder Canyon, Santa Rosa I., S. B. M. Nos. 6002 and 6003. Det. by I. M. Johnston.

Plagiobothrys californicus (Gray) Greene var. gracilis Jtn.

On Santa Cruz I. above Ladys Harbor. S. B. M. No. 10,361. Det. I. M. Johnston. The var. *fulvescens* Johnston, occurs on Santa Cruz I., S. B. M. Nos. 11,187, 5498, 5480, and 352; on San Miguel I., S. B. M. No. 11,905; and on Anacapa I., S. B. M. Nos. 6627, 6088.

Plagiobothrys canescens Benth.

Common on grassy slopes, Santa Rosa I. S. B. M. Nos. 10,360 and 5995. Det. by I. M. Johnston.

Marrubium vulgare L.

Frequent on Santa Cruz I.* in waste ground and on stony ridges along sheep trails, as well as at the landing place at Orizaba Harbor. On Santa Rosa I. there is a patch in a flat in the canyon near the ranch.

Lamium amplexicaule L.

A dozen plants near the cabin at Portezuela, Santa Cruz I.

Datura meteloides DC.

Occasional in lowlands, Santa Rosa I., April 9, 1930.

Petunia parviflora Juss.

Common in bed of stream near the ranch, Santa Rosa I.

Lycium fremontii Gray.

One bush on sea cliff, two miles west of Arlington Canyon, Santa Rosa I. S. B. M. Nos. 10,081 and 12,187. Det. by C. L. Hitchcock.

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* (Clokey).

SOLANUM CLOKEYI Munz. (S. ARBORESCENS Clokey, not Moench.)

In flower at Pelican Harbor, Santa Cruz I., Feb. 21, 1932. Other specimens Santa Cruz I., Ladys Harbor, Pelican Bay, Fry's Harbor, Cuesta Grade. S. B. M. Nos. 5165, 1082, 10,916, 11,760.

ANTIRRHINUM GLANDULOSUM Lindl.

One plant in a crevice of a steep rock wall above Diablo Stream, but near its mouth, Santa Cruz I., S. B. M. No. 12,040.

LINARIA CANADENSIS Dum. var. TEXANA (Scheele) Pennell.

San Miguel I., grassy slope, April 10, 1930. B. Norris.

SCROPHULARIA CALIFORNICA Cham.

Santa Rosa I., one plant on canyon bank.

MIMULUS FLORIBUNDUS Dougl.

A small colony in a deep canyon tributary to "Short" Canyon, Santa Rosa I. S. B. M. No. 12,073.

CASTILLEJA PARVIFLORA Bong. var. CALIFORNICA (Abrams) Zeile.

Santa Cruz I., on bank above stream, Pelican Bay, S. B. M. No. 11,604. Det. D. D. Keck. Santa Rosa I., where frequent on brushy banks, S. B. M. No. 5955. The var. *douglasii* Jeps. also occurs on both these islands.

CASTILLEJA LATIFOLIA H. & A.

Sandy mesa and beach at west end of Santa Rosa I., and at Carrington Point. S. B. M. Nos. 10,035, 12,124, 10,075, 9215.

ORTHOCARPUS DENSIFLORUS Benth.

Frequent on grassy mesas, Santa Rosa I.

ORTHOCARPUS PURPURASCENS Benth.

Occasional on grassy hills, Santa Cruz and San Miguel Is.

OROBANCHE CALIFORNICA C. & S.

One collection from canyon bank in Elder Canyon, Santa Rosa I., S. B. M. Nos. 10,080.

OROBANCHE GRAYANA G. Beck (OROBANCHE COMOSA Hook).

One colony on sandy mesa at west end of Santa Rosa I., S. B. M. No. 4041.

OROBANCHE FASCICULATA Nutt.

On *Eriophyllum,* above water canyon, Santa Rosa I., S. B. M. No. 12,047.

OROBANCHE UNIFLORA L.

On shaded banks on north side Santa Cruz I., S. B. M. Nos. 9167 and 11,744.

Plantago bigelovii Gray.

Abundant on mesa west of ranch, Santa Rosa I., S. B. M. Nos. 12,065, 5951.

Plantago hirtella H. B. K.

Common on springy sea cliffs at "Water Hole," China Harbor, Santa Cruz I., S. B. M. No. 10,469. Also on springy bank, Arlington Canyon, Santa Rosa I., S. B. M. Nos. 10,068 and 10,085.

Plantago maritima L.

Springy bank, Arlington Canyon, Santa Rosa I., S. B. M. No. 10,083.

Galium angustifolium Nutt. var.

A plant determined by Miss M. Hilend as an undescribed variety of this species is frequent on brushy or rocky banks, Santa Cruz, Santa Rosa and Anacapa Is. It is characterized by a very dense arrangement of its short leaves. S. B. M. Nos. 1046, 5573, 5945, 5595, 8642, 5503, 5440, 9426, 10,313, 10,799, 10,794.

Galium miguelense Greene.

Under oaks on Black Mt., at Arlington Creek, and west end of Santa Rosa I., S. B. M. Nos. 10,473, 10,474, 10,472, 12,125. Also on grassy slope above the west shore of Cuylers Harbor, San Miguel I., S. B. M. No. 9220.

Galium aparine L.

Frequent on north side of steep banks, San Miguel I.

Specularia biflora (R. & P.) Gray.

On shady banks, Santa Rosa I., S. B. M. No. 5944.

Githopsis specularioides Nutt.

Frequent on steep gravelly slope above Diablo Canyon and above Pelican Canyon, Santa Cruz I., S. B. M. No. 11,936.

Cichorium intybus L.

A few plants along the road one mile above Christys Harbor, Santa Cruz I.

Microseris aphantocarpha Gray var. elegans (Greene) Jeps.

On bare summits and mesas, Santa Rosa I. and San Miguel I.

Rafinesquia californica Nutt.

Santa Rosa I., on bushy banks in shade, S. B. M. No. 904.

Tragopogon porrifolius L.

Established on grassy slope near Main Ranch, Santa Cruz I., S. B. M. No. 9940.

Hypochoeris glabra L.

Fairly widely distributed in open places, Santa Rosa I.

Lactuca scariola L.

In neglected garden patch at the ranch, Santa Rosa I.

Sonchus asper L.

San Miguel I., on wet slopes, April 10, 1930.

Sonchus oleraceus L.

Scattered everywhere in open ground, San Miguel I.

Sonchus tenerrimus L.

San Miguel I., on grassy slope, March 25, 1927. S. B. M. No. 1069.

Malacothrix coulteri Gray var. cognata Jeps.

On sea cliffs at south side of Santa Cruz I., and on Santa Rosa I., on steep slopes above Tranquillon Canyon near the mouth and in "Short" Canyon. S. B. M. Nos. 6643 and 12,099.

Malacothrix saxatilis (Nutt.) T. & G.

The var. *implacata* (Eastw.) Hall is common on sea cliffs and steep canyon walls, Santa Cruz, Santa Rosa, San Miguel and Anacapa Is. Var. *tenuifolia* Gray occurs on Santa Cruz, Santa Rosa and Anacapa Is., S. B. M. Nos. 4129, 4067, 10,517.

Agoseris apargioides Greene.

On rocky slopes, Green Canyon, Santa Rosa I., April 16, 1929. Det. by H. M. Hall.

Agoseris heterophylla (Nutt.) Greene.

Frequent on grassy hillsides near Torrey Pines, Santa Rosa I., S. B. M. Nos. 9458, 6029.

Isocoma veneta (H. B. K.) Greene.

Var. *vernonioides* (Nutt.) Jeps. On Santa Cruz I., near China Harbor, S. B. M. No. 10,279.

Var. *sedioides* (Greene) Jeps. Common on sea cliffs and canyon banks, Santa Cruz I., S. B. M. No. 4131; and on Santa Rosa I. at west end. Det. H. M. Hall.

Var. *decumbens* (Brandegee) Jeps. On sea cliffs and canyon walls, Santa Rosa I., S. B. M. No. 2691; and Anacapa I., S. B. M. No. 10,278.

Corethrogyne filaginifolia (H. & A.) Nutt.

Var. *robusta* Greene. On San Miguel I. it occurs among high rocks in the southeast portion, also on the top of Princes I., S. B. M. No. 9464. On Santa Rosa I., it is also found, at Lobo Canyon, and near Tranquillon Canyon, S. B. M. Nos. 81, 6012, 10,521, 12,163 and 12,164—the first three numbers determined by H. M. Hall.

Var. *virgata* (Benth.) Gray. Santa Rosa I., where it is common on rocky slopes in the interior, S. B. M. No. 10,509. On Santa Cruz I. it is occasional in rocky grounds in the interior, S. B. M. No. 10,411. Det. by H. M. Hall.

Aster chilensis Nees.

Abundant on springy bank at "Water Hole," China Harbor, Santa Cruz I., S. B. M. No. 10,452.

Aster exilis Ell.

Common on springy bank at "Water Hole," China Harbor, Santa Cruz I., S. B. M. No. 10,416.

Aster radulinus Gray.

Santa Rosa I., head of Lobo Canyon, S. B. M. No. 6013.

Erigeron canadensis L.

Frequent along streams, Santa Rosa I.

Micropus californicus F. & M.

Locally common on dry slopes, Santa Rosa I., S. B. M. Nos. 6083 and 5953.

Filago californica Nutt.

A few plants in desiccated spots on the mesa at the west end of San Miguel I., S. B. M. No. 11,925.

Psilocarhus tenellus Nutt.

Occasional on flood plains and about hill tops, Santa Cruz I., S. B. M. Nos. 5492, 5491 and 925. A few plants in the dry bed of the stream in canyon west of Cañada de la Casa, Santa Rosa I., S. B. M. No. 12,108.

Evax caulescens Benth. var. humilis Jeps.

A dwarf plant answering to the description of this variety was found on clayey slopes south of summit, Santa Rosa I., S. B. M. Nos. 12,094 and 12,087.

Gnaphalium bicolor Bioletti.

Frequent on brushy banks, Santa Rosa I., S. B. M. Nos. 535, 6085, 6053, 6055 and 6056. Det. by H. M. Hall.

GHAPHALIUM CHILENSE Spreng.

Common on sea cliffs and flood plains, Santa Cruz I., and on open mesas near the sea, Santa Rosa I., also on Anacapa I.

Var. *confertiflorum* Greene. Occasional in sand on the bare ridge above Tranquillon Canyon, Santa Rosa I., and on sandy and rocky slopes, San Miguel I.

GNAPHALIUM PALUSTRE Nutt.

Occasional on flood plains, Santa Cruz I.

GNAPHALIUM WRIGHTII Gray.

Santa Cruz I., from near Buena Vista and from the vineyard at the Main Ranch. Det. by H. M. Hall.

PLUCHEA CAMPHORATA (L.) DC.

A few plants on a springy sea-cliff, China Harbor, Santa Cruz I.

HEMIZONIA PANICULATA Gray.

In open fields at the west end of Santa Cruz I.

ACHYRACHAENA MOLLIS Schauer.

Common on grassy slopes and ridges, Santa Rosa I.

FRANSERIA BIPINNATIFIDA Nutt.

Common on beaches and in sandy stretches near the sea, Santa Rosa I.; also on Anacapa I.

FRANSERIA CHAMISSONIS Less.

Not only on San Miguel as reported by Brandegee, but also on Santa Cruz I., where it was found on the beach at Cochies Prietos. Det. by H. M. Hall.

XANTHIUM SPINOSUM L.

San Miguel I., in East Canyon and in the canyon going from the ranch to Cuyler's Harbor.

LASTHENIA GLABRATA Lindl.

On Santa Rosa I., about a marsh at the east end; intermediate with the var. *coulteri* Gray.

BAERIA HIRSUTULA Greene.

Mesas near the sea, San Miguel I.; also Santa Rosa I. on mesas near the west end, and on sea-cliffs at the west end of Santa Cruz I.

ERIOPHYLLUM CONFERTIFLORUM Gray.

Common on rocky slopes, Santa Rosa I., S. B. M. Nos. 37, 12,048 and 12,049.

Var. *laxiflorum* Gray. Santa Rosa I. in Elder Canyon; det. by H. M. Hall.

PERITYLE EMORYI Torr.

Near the sea, at South Point, Santa Rosa I.

JAUMEA CARNOSA Gray.

Springy sea cliff at south side of Santa Cruz I.; and in salt marsh at east end of Santa Rosa I., as well as on a springy bank at the west end.

ANTHEMIS COTULA L.

Established about Prisoners Harbor, Santa Cruz I.*

MATRICARIA SUAVEOLENS (Pursh) Buch.

Occasional around the ranch house, Santa Rosa I.

COTULA AUSTRALIS Hook.

Santa Cruzz I., in waste ground, Main Ranch, Pelican Harbor, and in a burn on the summit of the ridge south of Pelican.

COTULA CORONOPIFOLIA L.

Santa Cruz I.* along the stream at Prisoners' Harbor; and Santa Rosa I., in stream beds and on springy banks.

SENECIO APHANACTIS Greene.

Santa Cruz I., on rocky slopes at the west end, S. B. M. Nos. 1110, 1109; Santa Rosa I., on a rocky ridge in the interior, S. B. M. Nos. 6082, 6072.

CYNARA SCOLYMUS L.

Escape from the garden at the Main Ranch, Santa Cruz I.

CIRSIUM CALIFORNICUM Gray.

Canyon bank, Cochies Priestos, Santa Cruz I., S. B. M. No. 11,204.

CIRSIUM OCCIDENTALE (Nutt.) Jeps.

Occasional on steep bank above Cuylers, San Miguel I., S. B. M. Nos. 9123, 9236.

Var. *coulteri* (Harv. & Gray) Jeps. is frequent on rocky slopes and canyon banks, Santa Cruz and Santa Rosa Is., S. B. M. Nos. 6032, 6048. Det. by H. M. Hall.

A peculiar low stout form with persistent white wool and red flowers suggestive of var. *candidissimum* Macbr. Occurs on Santa Rosa and San Miguel Is., S. B. M. Nos. 12,180, 10,519, 2758.

CENTAUREA SOLSTITIALIS L.

Established for half a mile along a stream bed above the Main Ranch, Santa Cruz I.

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*(Clokey).

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INDEX OF SUBJECTS

New genera, species, varieties and names indicated by bold face type.

INDEX OF AUTHORS

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Southern California Academy of Sciences

OFFICE OF THE ACADEMY

Los Angeles Museum, Exposition Park,
Los Angeles, Cal.

NOTES ON CERTAIN ORDOVICIAN FAUNAS OF THE INYO MOUNTAINS, CALIFORNIA

By Fred B. Phleger, Jr.

The purpose of this paper is to describe the faunas and stratigraphy of the Ordovician Barrel Spring and Mazourka formations as exposed in the Inyo range in east-central California.

During the fall of 1931 the writer spent several days collecting in the Inyo range with Dr. John H. Bradley, Jr. The field work was continued during the following winter and spring.

Ordovician rocks outcrop over a large area in the Inyo mountains, mainly in the southern part of the Bishop quadrangle and in the northern part of the Mount Whitney quadrangle. The best exposures for study occur in the vicinity of Mazourka canyon, east of Independence, California.

In 1912 and 1913, Adolph Knopf and Edwin Kirk made a reconnaissance geological survey of a large area in the vicinity of Owens valley which includes the Inyo range.[1] Kirk, in his study of the Ordovician section of the Inyos, recognized four divisions:

"The lowest is the basal sandstone 300 feet thick. Overlying this is a great series of limestones, probably of Beekmantown age. Above these limestones is a series of argillaceous limestones which is equivalent to the upper part of the Pogonip limestone and is of Chazy age. Apparently above these argillaceous limestones there is a series of arenaceous shales which is probably equivalent, at least in part, to the Palmetto formation of Turner. It is possible that rocks of Richmond age also occur in the range."[2]

PLATE 1.

[1] Knopf and Kirk, *U. S. Geol. Surv. Prof. Paper 110*, 1918.
[2] *Ibid.*, p. 32.

THE MAZOURKA FORMATION

The term, Mazourka formation, is here proposed to include a succession of argillaceous shales and limestones of lower Middle Ordovician age, 675 feet in thickness, underlain conformably by the Ordovician limestone which Kirk considers of Beekmantown age, and overlain conformably by the Barrel Spring formation. The beds strike north 35 degrees west and dip from 55 to 65 degrees southwest, and are exposed typically in Mazourka canyon between Barrel Spring canyon and the Lead canyon trail. The type section has been measured in an unnamed canyon which is the first tributary canyon entering Mazourka canyon on the east below the Elbow in Mazourka canyon. Two lithologic facies, a lower calcareous shale and an upper argillaceous limestone, mark the formation. The lower 125 feet, constituting the calcareous shale, is interbedded at irregular intervals with thin-bedded lenses of argillaceous limestone. It is dark gray on fresh fracture and weathers to a light gray. The lowest 75 feet is unfossiliferous, but in the overlying 50 feet scattered fragments of crinoids and trilobites occur on weathered surfaces. The shale beds grade into an argillaceous limestone, which is interbedded at infrequent intervals with a few thin shale layers. The limestone is dark gray on fresh fracture and weathers in light and dark discontinuous bands. It is abundantly fossiliferous and continues to the top of the formation.

In the type section the Mazourka formation is overlain with apparent conformity by the basal Devonian quartzite, which weathers white to buff. The absence of the Barrel Spring formation at this place may be due to faulting, since a short distance south of the type section extensive faulting has taken place. Farther south, in Barrel Spring and Mexican canyons, the Mazourka formation is overlain conformably by the basal quartzite of the Barrel Spring formation. The massive Beekmantown limestones, which underlie the Mazourka formation, weather white to buff.

The limestone of the Mazourka formation in most cases appears barren on fresh fracture. The fossils occur on weathered surfaces, and are found mainly in talus material. Weathering and recrystallization have combined largely to obliterate more minute characters and to make identification very difficult. The strata have also been sheared in places.

The Fauna of the Mazourka Formation

The following is a complete list of the fauna collected and identified by the writer from the Mazourka formation, including the forms also collected by Kirk:[3]

****Beatricea* sp. ind.
****(?) *Streptelasma* sp. ind.
**Diplograptus* sp.
****Blastoidocrinus carchariedens* Billings
****Prasopora contigua* Ulrich
****(?) *Chasmatopora* sp. ind.
****Crania* sp. ind.
****Orthis minusculus* sp. nov.
****Plectorthis mazourkaensis* sp. nov.
****Plectorthis patulus* sp. nov.
**Triplesia* sp.
Ctenodonta hamburgensis (Walcott)
**Modiolopsis* sp.
Pleurotomaria sponsa Billings
Hormotoma sp. ind.
Liospira sp. ind.
**Fusispira* sp.
Maclurites (?) *subannulata* (Walcott)
Maclurites sp. ind.
****Trochonema* sp. ind.
Endoceras proteiforme Hall
****Lloydia obsoletus* sp. nov.
**Nileus* sp.
****Isotelus gigas* DeKay
****Isotelus* sp. ind.
****Bumastus* sp. ind.
****Encrinurus hastula* sp. nov.
****Encrinurus octonarius* sp. nov.
****Cybeloides calliteles* sp. nov.
****Ceraurus infrequens* sp. nov.
Pliomerops barrandei Billings
Leperditia bivia White
****Leperditia nana* Jones
**Leperditella* sp.

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[3] *Op. cit.*, p. 35.
* Included in Kirk's faunal list and not collected by the author.
** Species not collected by Kirk.

The Age of the Mazourka Formation

Most of the new species from the Mazourka formation described in this paper are closely related to known Chazy types from other localities. These together with the Mazourka specimens which fall into previously described Chazy species from other localities constitute about 75 per cent of the Mazourka Fauna.

About 20 per cent of the remaining species have been found elsewhere in rocks of Trenton age. The abundance of gastropods is a notable characteristic of the fauna; six genera are represented, and of these three are extremely common throughout the formation. The Mazourka formation is faunally a unit and undoubtedly of Chazy age.

Correlation with Strata Elsewhere

Kirk correlates the Mazourka formation with the upper Pogonip of the Eureka district, Nevada, described by Hague. The term "Pogonip" has been used in Nevada in various ways. Hague's[4] use of the term includes strata of Beekmantown, Chazy, and Trenton ages, with a maximum thickness of 5,000 feet. Emmons[5] and Spencer[6] used the term "Pogonip" to include beds containing Ordovician fossils between Cambrian strata and the Eureka quartzite, which is stratigraphically lower than a limestone carrying Trenton fossils. Over 15 per cent of the Mazourka species are closely related to species reported by Hague from the middle part of his section. Since this middle part of Hague's fauna is of Chazy age, it would appear that the Mazourka formation may be equivalent, in part at least, to his middle Pogonip. Walcott's faunal list of the upper Pogonip of the Eureka district[7] includes species of Chazy age. About 25 per cent of the species from the Mazourka formation are either identical with or are closely related to species which Walcott reported. The two formations may be partially contemporaneous.

There is a similarity between the fauna of the lower part of the Simpson formation of Oklahoma[8] and that of the Mazourka formation. About 20 per cent of the Mazourka forms are represented in the lower Simpson by identical or related forms. It is probable that the two formations are partly contemporaneous.

The Swan Peak quartzite of Idaho carries a small fauna of

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[4] Hague, Arnold, *Geol. of the Eureka Dist., Nev.; U. S. Geol. Surv. Mon. 20*, pp. 48-54.

[5] Emmons, S. F., *U. S. Geol. Surv. Bull. 308*, pp. 27-29.

[6] Spencer, A. C., *U. S. Geol. Surv. Prof. Paper 96*, pp. 25, 26.

[7] Walcott, C. D., *U. S. Geol, Surv. Mon. 8*, pp. 65-98.

[8] Edson, F. C., *Notes on the Simpson Formation of Oklahoma, Bull. Am. Ass. Pet. Geol.*, vol. 7, 1923, pp. 558-64.

questionable Chazy age. Mansfield gives no faunal list in his papers[9] but Richardson* lists eight forms. This formation is a possible correlative of the Mazourka formation.

A fairly close correlation by means of fauna can be made between the Mazourka formation and the type Chazy formation of New York and Canada. About 50 per cent of the Mazourka forms which have been specifically identified are either identical with or closely related to forms occurring in the Chazy of the eastern section.

THE BARREL SPRING FORMATION

The term, Barrel Spring formation, is here proposed to include a succession of quartzites, impure limestones, and argillaceous shales of Middle Ordovician age, in the Inyo mountains. The formation is 130 feet in thickness, overlain conformably by basal Devonian quartzite and underlain conformably by the argillaceous limestones of the Mazourka formation. The type section has been measured in the south fork of Mexican canyon, which is the second canyon north of Barrel Spring canyon. The beds strike north 15 degrees west and dip from 60 to 70 degrees southeast. They are well exposed in Barrel Spring canyon and in each of the next four canyons to the north. Three lithologic facies: a basal quartzite, an impure limestone, and an argillaceous shale, mark the formation. The lower 41 feet, constituting the quartzite, is very resistant and stands out in bold relief. It is white in color and is unfossiliferous. The overlying 25 feet consists of an impure limestone which is only slightly less resistant to weathering than the quartzite, and is also unfossiliferous. It is dark gray on fresh fracture and weathers to a lighter gray. The limestone beds grade into an argillaceous shale which is 64 feet thick and continues to the top of the formation. It is dark gray to black on fresh fracture and weathers to a reddish-brown color. The shale is highly fossiliferous at certain localities.

Fossils appear in most cases on fresh fracture as an iron replacement which weathers to limonite. The better specimens are preserved as molds and casts. The best locality for collecting is in the exposures of the shale member on the north slope of Barrel Spring canyon about one-half mile east of Barrel Spring.

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[9] Mansfield, G. R., *U. S. Geol. Surv. Prof. Paper 152*, p. 57. *U. S. Geol. Surv. Bull. 713*, pp. 32, 33.

* Richardson, G. S., *Am. Jour. Sci.*, Vol. 186.

Fauna of the Barrel Spring Formation

The following is a list of the fauna collected by the writer from the Barrel Spring formation:

Orthis tricenaria Conrad
Orthis decipiens sp. nov.
Plectambonites angulatus sp. nov.
Orthoceras sp. ind.
Remopleurides occidens sp. nov.
Isotelus gigas DeKay
Isotelus spurius sp. nov.

Five of the seven forms which are present in the fauna of the Barrel Spring formation are either identical with or are closely related to species of Trenton age.

Correlation with Strata Elsewhere

Due to the paucity of the fauna of the Barrel Spring formation and also because of incomplete information concerning Ordovician faunas of Trenton age in western United States, it is impossible to correlate this formation with strata elsewhere in the west. Hague[10] assigns a Trenton age to the uppermost part of his Pogonip formation. It is possible that the Barrel Spring formation is contemporaneous with some part of Hague's upper Pogonip, although no related species occur in common at both localities.

It is also possible that the Barrel Spring formation is the equivalent of some part of the upper Simpson formation of Oklahoma. Although no species occur in common at the two localities, there are two or three species which are distantly related.

ACKNOWLEDGMENTS

The writer wishes to acknowledge the assistance of Dr. John H. Bradley, Jr., at whose suggestion this problem was begun and whose constant supervision has made its completion possible. Dr. Chester Stock helped in the preparation of the illustrations, and Dr. John A. Comstock and the members of the Southern California Academy of Sciences have been generous in affording a medium of publication.

The types described in this paper, the gift of Dr. Bradley and the author, are in the Los Angeles Museum.

[10] Hague, *op. cit.*, pp. 48-54.

DESCRIPTIONS OF SPECIES OCCURRING IN THE MAZOURKA FORMATION

Phylum Molluscoidea
Class Brachiopoda Duméril
Order Protremata Beecher
Superfamily Orthacea Walcott and Schuchert
Family Orthidae Woodward
Subfamily Orthinae Schuchert and Cooper
Genus Orthis Dalman

Orthis minusculus sp. nov.
Plate II, Figs. 6, 7

Shell small, semi-oval; sides gently convex or concave just below the cardinal extremities, gently converging for about one-half the length, forming a broadly rounded curve latero-anteriorly, the anterior margin only gently convex. Width of pedicle valve of a cotype 10 mm., length 7 mm. Valves equally convex. The brachial valve is uniformly convex, with a narrow, fairly distinct mesial sinus extending the full length of the shell. The pedicle valve is uniformly convex, with a small portion at the cardinal angles depressed; the beak is large, broadly convex, and appears to overhang the hinge line a little. The surface is marked by twenty simple rounded plications, averaging three plications to three millimeters at the anterior margin. Internal characteristics unknown.

This species resembles *Orthis euryone* Billings, from the Canadian beds of Quebec, except that it has fewer plications, the mesial sinus in the brachial valve is narrow and distinct and extends the entire length of the shell, and the brachial valve is not flat. *O. minusculus* is closely related to *O. ignicula* Raymond, from the Chazy of Valcour Island, N. Y., but it does not have the difference in convexity of valves shown in *O. ignicula*. *O. acutiplicata* Raymond, from the Chazy of Valcour Island, has fewer plications than *O. minusculus*. A close relative seems to be *O. laurentia* Billings, from the Gamachian of Canada. In the description given by Billings, however, no mention is made of a mesial sinus. The difference in relative convexity of valves is greater in *O. laurentia* than in the species here described.

Horizon and locality: Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

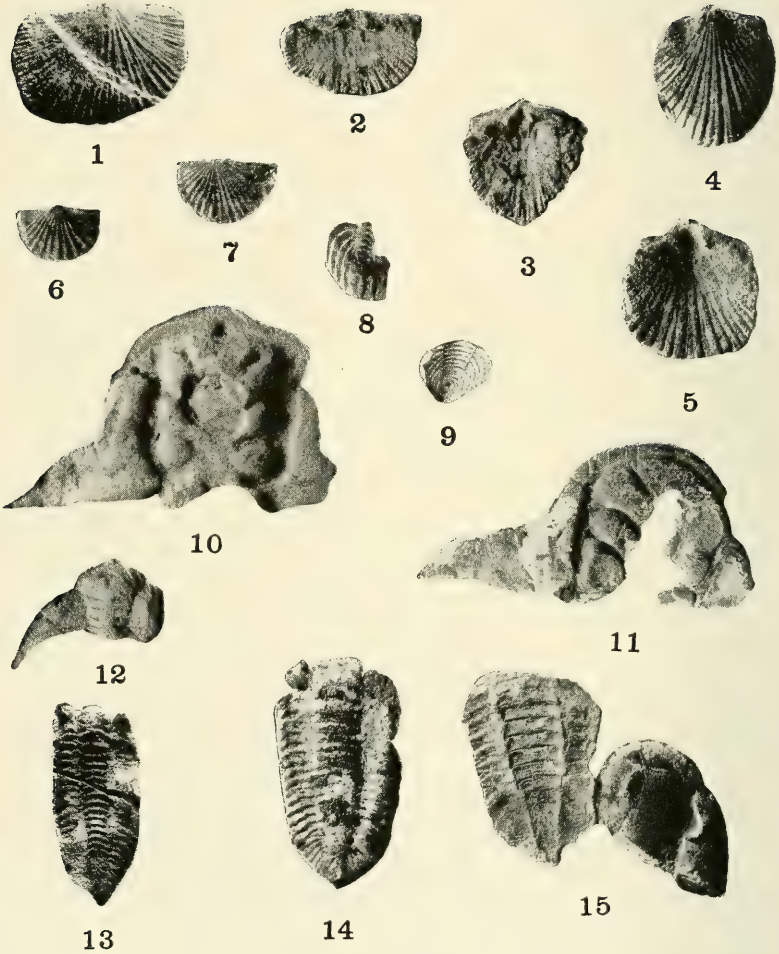


PLATE 2.

Family Plectorthidae Schuchert and Cooper

Subfamily Plectorthinae Schuchert and Cooper

Genus Plectorthis Hall and Clarke

Plectorthis mazourkaensis sp. nov.

Plate II, Figs. 3, 4, 5

Valves subequally convex, the pedicle valve a little more so than the brachial; the lateral margins are rounded anteriorly, straight or slightly rounded posteriorly. Outline semioval to subquadrate; the hinge line a little less than the greatest width. The width of an average specimen varies from 17 to 18 mm., length from 16 to 17 mm., forming a ratio of breadth to length of approximately 1:1, the breadth in some cases being 1 to 2 mm. greater than the length. The surface of both valves is marked by from 18 to 20 primary plications, subangular to rounded, increasing to about 35 at the anterior margin by bifurcation 5 to 8 mm. from the beak. Usually one minor and less prominent plication is added in this manner to each major plication, frequently two, rarely none. No example of implantation was seen. At the anterior margin there are five to six plications to 4 mm.

In the brachial valve a shallow but fairly distinct mesial sinus extends from the beak, usually broadening anteriorly. In front of the cardinal angle on either side is a flat, depressed area.

The pedicle valve is gently convex, with a slight flattening at the cardinal angles, and the suggestion of a low median fold. Umbo flattened, with the beak not perceptably incurved; the foramen is triangular; the cardinal area is concave, about 1 mm. deep. The muscle scars are vague in the specimens at hand, but they seem to form a subelliptical area, extending anteriorly from the region of the beak about one-fifth the length of the shell; the components are not easily distinguishable but there is a faint median ridge extending most of the length. In the interior of the pedicle valve the plications are clearly observed extending from the anterior margin almost to the cardinal area.

This is the most common species in the Mazourka formation. It is closely related to *Plectorthis exfoliata* (Raymond), from the lower Chazy at Valcour, New York, except that the bifurcation takes place regularly in all the Mazourka specimens. *P. whitfieldi* (N. H. Winchell) has a longer and more complex muscle impression. *P. jamesi* (Hall), from the Maysville of Ohio, is considerably longer than it is wide, and it also has a tendency towards gibbosity in the brachial valve, as well as a greater number of plications which bifurcate near the anterior margin. No specimen examined shows the quadrate muscle scar of *P. scovillei* (Miller),

from the Richmond of Ohio. A very distant relative, *Dalmanella hamburgensis* (Walcott), is found in the Pogonip of Nevada.

Horizon and locality: Mazourka formation, in Mazourka canyon about one-half mile below the Lead canyon trail, Inyo mountains, California.

Plectorthis patulus sp. nov.
Plate II, Figs. 1, 2

Valves subequally convex, the pedicle valve only a little more convex than the brachial; outline transversely oval to subquadrate, lateral margins straight, rounded anteriorly and slightly convex on the anterior margin; the hinge line is a little less than the greatest width of the shell. Width of both valves 17 to 25 mm., length 11 to 15 mm., forming a ratio of breadth to length of about 5:3. The surface of both valves is marked by 20 to 22 primary, subrounded plications which increase by bifurcation anywhere from the posterior to the anterior margin to from 40 to 48 plications at the anterior margin; in most cases one plication is added to each primary plication by bifurcation, but in some cases two and not infrequently three are added in this manner; there is rarely any distinction in prominence at the anterior margin between the primary and secondary plications. At the anterior margin there are four plications to 4 mm.

The brachial valve is evenly convex with a shallow, distinct mesial sinus extending from the beak the entire length of the valve, greatly widening anteriorly.

In the pedicle valve the umbo is high, sloping equally in all directions; there is a slight flattening at the cardinal angles; the beak is not perceptably incurved; the cardinal area is narrow, the greatest width being 2 mm.; foramen triangular.

In *Plectorthis exfoliata* Raymond from the Chazy at Chazy, N. Y., the bifurcation is neither so regular nor so abundant as in *P. patulus*. *P. patulus* differs from *P. mazourkaensis* from the Mazourka formation in the ratio of breadth to length, being considerably wider than long; also in having a greater number of secondary plications, and the fact that these plications are as prominent at the anterior margin as the primary plications; and in having a wider foramen and a considerably smaller muscle impression. The specimens at hand show no evidence of the gibbosity in the brachial valve shown in *P. jamesi* (Hall), from the Maysville. They have fewer and more prominent plications than *P. kankakensis* (McChesney), from the Fernvale of Illinois. *P. neglecta* (James), from the Maysville of Ohio, has very narrow grooves between the plications. No near relatives of *P. patulus* have been listed from any formation east of Illinois.

Horizon and locality: Mazourka formation, in Mazourka canyon one-half mile below the Lead canyon trail, Inyo mountains, California.

Phylum Arthropoda
Class Crustacea
Subclass Trilobita Walch
Order Opisthoparia Beecher
Family Asaphidae Burmeister
Genus Lloydia Vogdes

Lloydia obsoletus sp. nov.
Plate II, Fig. 15

Cephalon moderately convex, broadly rounded anteriorly. Glabella large, oblong, most elevated opposite the eyes and gently sloping downward to the anterior margin; sides sub-parallel, front margin gently rounded; occipital furrow somewhat indistinct in the type specimen, but appearing to extend in a straight line across the glabella. Eyes large, about one-half as wide as the glabella, crescentiform, situated very near the glabella and about halfway between the posterior and anterior margins.

The thorax is a little longer than the cephalon, with a distinct axial lobe about two-thirds as wide as the pleural lobes, and divided into eight smooth segments. The pleural segments appear to extend laterally into short, blunt spines.

The pygidium is rather long, subrounded to subtriangular, with a well-defined axial lobe which is about half as wide as the pleural lobes and extends almost to the posterior margin. The axial lobe narrows posteriorly and there is no trace of segmentation.

Measurements of Cotypes

Cranidium	
Length	15 mm.
Width	10 mm.
Distance from eyes to posterior margin of glabella	6 mm.
Thorax	
Length	16 mm.
Width	16 mm.
Width of axial lobe	8 mm.
Pygidium	
Length	11 mm.
Width	15 mm.

Lloydia obsoletus is closely related to *L. strenuus* (Billings), from the Beekmantown of Quebec, but it differs in having the eyes close to the glabella. *L. oblongatus* (Billings) differs from *L. obsoletus* mainly in having small eyes situated well away from the glabella.

Horizon and locality: Mazourka formation, about one-half mile below the Lead canyon trail in Mazourka canyon, Inyo mountains, California.

Order Proparia Beecher
Family Encrinuridae Angelin
Genus Encrinurus Emmrich

Encrinurus hastula sp. nov.
Plate II, Figs. 13, 14

Cranidium sub-lunate in outline, the anterior and lateral margins more or less regularly rounded, with the posterior margin broadly sinuous, and the posterior extremities bluntly subtriangular. The facial sutures originate in front of the genal angles and pass obliquely forward and around the eyes, intersecting the anterior margin at points a little nearer together than the breadth between the eyes. Eyes small and prominent, situated on conical protuberances fairly close to the glabella. The glabella is prominent and is separated from the fixed cheeks by deep, dorsal furrows. The sides are nearly parallel for the posterior third of the length, but converge slightly farther forward. The anterior margin is broadly rounded. There are two pairs of prominent glabellar furrows which curve posteriorly only slightly; each furrow extends about one-third the width of the glabella. The neck segment is prominent, with median spine, and is separated from the glabella by a well-defined occipital furrow.

The thorax consists of eleven segments. The median lobe is about equal in length to the pleural lobes and is slightly more convex, with an increased convexity on the first two or three segments. The segments of the pleural lobes end laterally in blunt spines which curve posteriorly at their extremities.

The pygidium is subtriangular in outline, slightly wider than long. The lateral margins are straight or slightly convex, with the posterior extremity rounded or subtriangular. The axial lobe is narrow, with tapering sides, terminating in the posterior margin of the pygidium and showing about twenty segments. There are twelve segments on the pleural lobes. The anterior segments are directed laterally for a short distance and are there deflected posteriorly through a broad curve. The posterior deflection of the succeeding segments becomes more marked, until the twelfth pair extends parallel to the axial lobe.

Measurements of Cotypes

Cranidium	Average Specimen	Small Specimen
Width - - - - - - - -	21 mm.	10 mm.
Length - - - - - - - -	.....	4 mm.
Length of glabella - - -	.....	4 mm.
Width of glabella - - -	9 mm.	5 mm.

Thorax		
Length	23 mm.	12 mm.
Width	19 mm.	12 mm.
Pygidium		
Length	20 mm.	10 mm.
Width	17 mm.	10 mm.

Encrinurus trentonensis Walcott, from the Trenton of New Jersey, is a smaller form with the pleurae of the pygidium arising from alternating median segments. *E. hastula* may be distinguished from *E. tuberculosus* Collie, from the Trenton of New Jersey, by having more pleurae on the pygidium, and also fewer annulations on the median lobe. *E. deltoides* Shumard, from the upper Medinan of Illinois, may be distinguished by its greater number of segments (24) along the median lobe, and less number of segments (8) along the lateral lobes of the pygidium. *E. americanus* Vogdes, from the Clinton of Georgia, has only six pleurae on the pygidium. *E. thresheri* Foerste, from the upper Medinan of Indiana, has seven lateral segments in the pygidium and the segments are narrower than the intervening grooves. Tubercles are also present on the median lobe.

Horizon and locality: Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

Encrinurus octonarius sp. nov.

Plate II, Fig. 9

Pygidium fairly convex, subtriangular in outline, length and breadth equal. The lateral margins are straight, with the posterior extremity subtriangular. The axial lobe is a little greater in width than the pleural lobes at the anterior end of the pygidium, but it rapidly tapers posteriorly to about half the width of the pleural lobes at the posterior extremity. The axial lobe shows ten segments clearly and there are ten or twelve more posterior to these which are obscured in the holotype. There are eight segments on the pleural lobes. The anterior segments are deflected posteriorly through a broad curve. The posterior segments extend directly posteriorly. The rest of the pleurae are transitional between these two extremes. Cephalon and thorax unknown.

Measurements of Holotype

Length	9 mm.
Width	10 mm.
Width of axial lobe at anterior margin	4 mm.
Width of axial lobe at posterior margin	1.5 mm.
Width of pleural lobes	3 mm.

Encrinurus octonarius differs from *E. hastula* Phleger, which is also from the Mazourka formation, in being equal in length and breadth and in having only eight pleurae. *E. americanus* Vogdes has six pleurae on the pygidium. *E. trentonensis* Walcott, from the Trenton of New Jersey, differs from *E. octonarius* in that the pleurae arise from alternating segments of the median lobe.

Horizon and locality: Mazourka formation, in Mazourka canyon at the Elbow, Inyo mountains, California.

Genus Cybeloides Slocom

Cybeloides calliteles sp. nov.
Plate II, Fig. 8

Pygidium suboval to subtriangular, about as wide as long, with a narrow, well-defined median lobe and well-defined side lobes. The median lobe is traversed by five furrows, forming five small segments with a sixth larger segment at the posterior extremity. The side lobes are produced in five pointed spines which curve distally until parallel to the axial lobe. The first spine extends laterally for about one-third its length and is there abruptly rounded for the second third, whereas the last third is parallel to the axial lobe. The fifth spine extends straight backwards, curving slightly outward and around the posterior segment of the median lobe. The shape of the second, third, and fourth spines is transitional between these two extremes. The spines are separated from each other by deep furrows which become 1 mm. wide at their distal extremities.

Cybeloides calliteles differs from *C. mirus* Billings, from the Chazy of Tablehead, Newfoundland, in having fewer segments in the pygidium, and in having more pleurae. It differs from *C. primus* (Raymond), from the Chazy of New York, in having fewer segments and in lacking nodes along the axial lobe of the pygidium.

Horizon and locality: Mazourka formation, at the Elbow in Mazourka canyon, Inyo mountains, California.

Family Cheiruridae Salter
Subfamily Cheirurinae Raymond
Genus Ceraurus Green

Ceraurus infrequens sp. nov.
Plate II, Fig. 12

Cephalon broad, roughly crescentiform, four-tenths as long as wide. Glabella only moderately convex, expanding forward at a rate of 1 mm. in a length of 3 mm. The front of the glabella is gently rounded; there are three pairs of glabellar furrows; the third pair is shorter than the other two and appears to be joined to the occipital furrow by faint longitudinal depressions, forming a third lobe roughly quadrangular in shape. The lobation is faint and not well-defined. The frontal lobe constitutes a little less than one-half the glabella. The occipital furrow is narrow but well-impressed. Occipital segment narrow, slightly elevated, curving a little anteriorly in traversing the middle of the glabella. The fixed cheeks are weakly convex, increasing somewhat in convexity in the palpebral region. The genal angles are produced laterally into short, curved spines. The eyes appear to be small, situated high on the cheeks, and a little nearer to the glabella than the posterior margin of the cephalon. No surface characteristics shown. Thorax and pygidium unknown.

Measurements of Holotype

Length of cephalon	8 mm.
Width of cephalon	27 mm.
Front width of glabella	8 mm.
Rear width of glabella	5 mm.
Length of glabella	8 mm.
Length of frontal lobe	3.6 mm.

This species differs from *Ceraurus granulosus* Raymond and Barton, from the Chazy of Valcour Island, in not having a rectangular-shaped glabella. *C. infrequens* is rather closely related to *C. bispinosus* Raymond and Barton from the Black River of Quebec, but in the latter the glabellar furrows are neither so distinct nor so continuous. *C. pleurexanthemus* from the Black River and Trenton does not have the rapid forward expansion seen in *C. infrequens*.

Horizon and locality: Mazourka formation, in Mazourka canyon at the Elbow, Inyo mountains, California.

SUBFAMILY Pliomerinae Raymond

GENUS Pliomerops Raymond

Pliomerops barrandei (Billings)

Plate II, Figs. 10, 11

Amphion barrandei Billings, *Pal. Fossils,* 1, *Geol. Surv. Canada,* 1865, p. 208, figs. 277a, b.

Pliomerops barrandei Raymond, *Ann. Car. Mus.,* 7, 1910, p. 76, fig. 7.

Pliomerops nevadensis (Walcott), *Mon. U. S. Geol. Surv.,* 8, 1884, p. 94, pl. 12, fig. 13.

Kirk reported the presence of *Pliomerops nevadensis* (Walcott) in the beds of the Mazourka formation. The present species is very abundant and is undoubtedly the species to which Kirk had reference.

A comparison of the description and illustration of *Pliomerops barrandei* (Billings) with that of *P. nevadensis* (Walcott), from the Pogonip of Nevada, brings to light only obscure differences. The first glabellar furrow of *P. nevadensis* may be, and probably is, the equivalent of the anterior oblique depression of *P. barrandei.* From Walcott's restored illustration, it would seem that this furrow was not actually observed to cut the front margin of the glabella. Also, the fragmentary condition of his material was mentioned in Walcott's description. It is probable, since so many specimens of *P. barrandei* from the Mazourka formation clearly show the arrestment of the first glabellar furrow before reaching the margin, and in all other regards resemble *P. nevadensis,* that Walcott's species is synonymous with *P. barrandei.*

Horizon and locality: Chazy of Quebec; Point Rich, Table Head, and other localities, Newfoundland; the most abundant trilobite in the Mazourka formation.

DESCRIPTIONS OF NEW SPECIES OCCURRING IN THE BARREL SPRING FORMATION

PHYLUM Molluscoidea
CLASS Brachiopoda Duméril
ORDER Protremata Beecher
SUPERFAMILY Orthacea Walcott and Schuchert
FAMILY Orthidae Woodward
SUBFAMILY Orthinae Schuchert and Cooper
GENUS Orthis Dalman

Orthis decipiens sp. nov.
Plate I, Fig. 2

Shell transversely oval in outline, wider than long, with divergent sides. The greatest width is at the hinge. The width of the brachial valve of the holotype at the hinge is 10 mm., at the anterior margin the width is somewhat less. The length is 6 mm. The brachial valve is moderately and uniformly convex, with a narrow, indistinct mesial sinus extending posteriorly from the hinge area for about half the length of the shell. The cardinal area is narrow. The surface is marked by about 30 simple rounded plications. At the anterior margin there are three plications to two millimeters.

Orthis decipiens differs from *O. ignicula* Raymond, from the Chazy of New York, in lacking a broad depression towards the anterior margin and also in having a very narrow cardinal area. It differs from *O. minusculus* Phleger, from the Mazourka formation of the Inyo mountains, in having a greater number of plications and in having more plications per unit width at the anterior margin. It also lacks the distinct and continuous mesial sinus of *O. minusculus*. It differs from *O. euryone* Billings, from the Canadian beds of Quebec, mainly in the convexity of the brachial valve.

Horizon and locality: Barrel Spring formation, in Barrel Spring canyon, Inyo mountains, California.

SUPERFAMILY Strophomenacea Schuchert
FAMILY Strophomenidae King
SUBFAMILY Rafinesquinae Schuchert
GENUS Plectambonites Pander

Plectambonites angulatus sp. nov.

Plate I, Fig. 1

Shell subquadrate in shape, usually wider than long, with a pair of lateral pointed projections at the hinge line. Measurements of an average specimen: width at mid-length 15 mm., width at hinge area 21 mm., length 10 mm. Surface finely striated, with three to four striations to one millimeter at the anterior margin. Pedicle valve evenly convex, but gently arched along the median line from beak to front; beak very small; delthyrium, known only from a cast, appears small but comparatively wide. On the interior of the pedicle valve the muscle scars form a bilobed area divided longitudinally by a slightly elevated area. Each lobe is long and slender with an abruptly rounded anterior projection; the outer ridges of the abductor areas are nearly straight with a very slight tendency to be curved in part.

Plectambonites angulatus differs from *P. curdsvillensis* Foerste, from the Trenton Curdsville formation of Kentucky, in not having a thickening near the anterior and lateral margins, in having less crescentic-shaped muscle scars, and in having fewer striae per millimeter width. It differs from *P. sericeus* (Sowerby) mainly in having no alternation in the prominence of the striae and in being somewhat larger.

Horizon and locality: Barrel Spring formation, in Barrel Spring canyon east of Barrel Spring, Inyo mountains, California.

Phylum Arthropoda
Class Crustacea
Subclass Trilobita Walch
Order Opisthoparia Beecher
Family Remopleuridae Corda
Genus Remopleurides Portlock

Remopleurides occidens sp. nov.

Plate I, Figs. 3, 4

Cranidium rather strongly convex, anterior margin abruptly elevated; width of the neck segment and also the portion of the cranidium in front of the eyes a little more than half the width between the eyes. The facial suture originates at or very near the posterior margin of the palpebral lobes and curves upward and outward around the lobes in the form of a half oval, and there proceeds directly forward to produce a gently rounded curve anteriory. The occipital furrow is well-defined and deeply incised, traversing the cranidium in a straight line.

The thorax is a little wider than the cranidium, rather strongly convex, consisting of eleven segments. The axial lobe is wide and stands out in bold relief; it tapers sharply posteriorly to the pygidium. The side lobes are narrow, only slightly convex, produced in pointed pleurae which curve backwards and decrease in length posteriorly.

The pygidium is very small and rarely well preserved. One specimen shows a pygidium which is produced in two pairs of short spines curving sharply to a directly posterior direction.

MEASUREMENTS

	Small	Average	Large
Cranidium			
Length	4 mm.	5 mm.	6 mm.
Width	4 mm.	5 mm.	6 mm.
Width directly in front of palpebral lobes	2 mm.	3 mm.	4 mm.
Thorax			
Length		11 mm.	13 mm.
Width		8 mm.	10 mm.
Posterior width		3.5 mm.	5 mm.
Pygidium			
Length		1 mm.	
Width		2 mm.	

Remopleurides occidens is closely related to *R. canadensis* Billings, from the Chazy of Valcour Island, but it differs in being more convex and in lacking glabellar furrows. *R. missouriensis* Foerste from the Kimmswick of Missouri differs from *R. occidens* in having a more rounded cranidium; and also the facial suture immediately anterior to the palpebral lobes is only slightly indented, whereas in *R. occidens* it is well indented. *R. affinis* Billings from the Beekmantown of Quebec differs from *R. occidens* in having the part of the cranidium anterior to the eyes less quadrate in shape, with the sides sloping and the front less abruptly rounded.

Horizon and locality: The most common fossil in the Barrel Spring formation, in Barrel Spring canyon, Inyo mountains, California.

Family Asaphidae Burmeister

Subfamily Asaphinae Raymond

Genus Isotelus DeKay

Isotelus spurius sp. nov.

Plate I, Fig. 7

Cephalon short, wide, gently convex, and either abruptly descending at the margins, or with a slightly flattened border. The eyes are large, situated about halfway to the front of the cephalon, moderately close together. The facial suture begins at a point well within the genal angles and proceeds forward and outward at an angle of about forty-five degrees; after swinging around inside the eye it proceeds forward and outward at about sixty degrees and meets the antero-lateral margin. Glabella not defined, glabellar furrows absent. The free cheeks are large, rounded at the genal angles.

The thorax has eight flat segments, with a wide axial lobe occupying more than two-thirds the width. Pleurae short, rounded.

The pygidium is wider than long, with a subrounded outline. It is gently convex, with a slightly flattened border. The axial lobe is only obscurely defined and apparently narrows abruptly posteriorly; no segmentation has been observed. A median furrow has been observed in one mold of a pygidium.

Measurements

Cephalon	
Length	9 mm.
Width	17 mm.
Distance from eyes to posterior margin	4 mm.
Distance between eyes	7 mm.
Pygidium	
Length	7 mm.
Width	13 mm.

Isotelus spurius is distinct in the abrupt rounding of the cranidium antero-laterally; in other species this region is more or less broadly rounded. It resembles *Homotelus* in this respect, and also in the abrupt descent of the anterior part of the cranidium; the absence of a median pustule on the cranidium, how-

ever, excludes it from that genus. *Isotelus spurius* differs from *I. latus* Raymond, from the Trenton of Ottawa, Ontario, in having larger eyes situated farther forward, and also in having a wider median thoracic lobe.

Horizon and locality: Barrel Spring formation, in Barrel Spring canyon east of Barrel Spring, Inyo mountains, California.

Plate I

1. *Plectambonites angulatus* Phleger. Cast of interior of pedicle valve of cotype. L. A. M. No. A3158-76.

2. *Orthis decipiens* Phleger. Cast of interior of brachial valve of holotype. L. A. M. No. A3158-70.

3, 4. *Remopleurides occidens* Phleger. Cranidium and thorax of cotypes. L. A. M. Nos. A3158-75, 73.

5, 6. *Isotelus gigas* DeKay. Cranidium and hypostoma of plesiotypes. L. A. M. Nos. A3158-71, 74.

7. *Isotelus spurius* Phleger. Dorsal view of cotype. L. A. M. No. A3158-69.

Plate II

1, 2. *Plectorthis patulus* Phleger. Exterior and interior of pedicle valves of cotypes. L. A. M. Nos. A3158-26, 22.

3, 4, 5. *Plectorthis mazourkaensis* Phleger. Interior, exterior and interior views of pedicle valves of cotypes. L. A. M. Nos. A3158-23, 52, 25.

6, 7. *Orthis minusculus* Phleger. Pedicle and brachial views of cotypes. L. A. M. Nos. A3158-30, 29.

8. *Cybeloides calliteles* Phleger. Pygidium of holotype. L. A. M. No. A3158-32.

9. *Encrinurus octonarius* Phleger. Pygidium of holotype. L. A. M. No. A3158-67.

10, 11. *Pliomerops barrandei* (Billings). Cranidia of plesiotypes. L. A. M. Nos. A3158-12, 13.

12. *Ceraurus infrequens* Phleger. Cranidium of holotype. L. A. M. No. A3158-56.

13, 14. *Encrinurus hastula* Phleger. Dorsal views of cotypes. L. A. M. Nos. A3158-65, 66.

15. *Lloydia obsoletus* Phleger. Mold of Thorax and pygidium and cephalon of cotypes. L. A. M. No. A3158-14.

RARE FISHES FOUND IN CALIFORNIA COASTAL WATERS

By Howard R. Hill

A specimen of the curious Louvar, (*Luvarus imperialis* Rafinesque), was taken at Redondo Beach on November 20, 1932, by Mr. Donald S. Perry of Hawthorne, California. It was found struggling in the surf in an apparently injured condition and killed with an improvised harpoon and dragged ashore.

The fish proved to be one of the largest of its kind ever taken and measured 6 feet, 1 inch in length and weighed 305 pounds. The Louvar has been recorded but once before in California waters when a specimen was secured at Avalon, Catalina Island, in 1901. It is most frequently found in the Mediterranean Sea but travels far and wide and is not common anywhere.

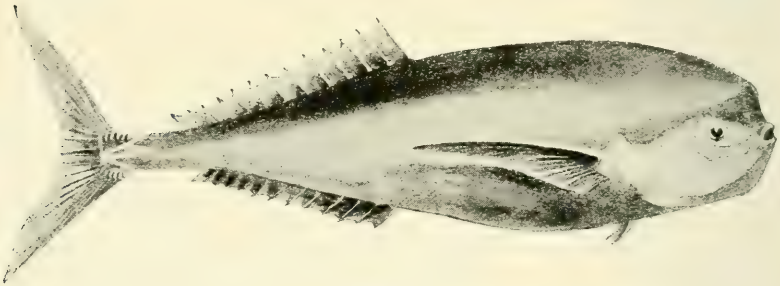


PLATE 3.

Louvar (*Luvarus imperialis*) 1/18 natural size.

The Redondo Beach specimen was characteristically marked with brilliant scarlet on the fins and a broad band of the same color in the head region. The mouth was comparatively small and the dentition weak. A peculiar, triangular flap, which is said to function like a valve, covered the anal opening.

At the Los Angeles Museum, a cast was made of the body in order to prepare a life-sized model for exhibition and the skeleton was preserved for future study.

During the latter part of November and the first week of December, 1932, a species of Cowfish appeared on the coast of Southern California. Numerous specimens were brought to the Los Angeles Museum for identification and were found to be

Ostracion diaphanum Bloch & Schneider, a native of Japanese and East Indian waters. This is the first American record for the species and it is difficult to explain why such a small, slow-moving fish should wander so far from its known range.

The body of the Cowfish is enclosed in a box-like carapace or outer shell from which the tail protrudes. The carapace is scaled with hexagonal bony plates which give it a mosaic appearance. It is a fish that lives near the bottom in shallow water. One of the specimens was taken alive near the kelp beds off Point Firmin, San Pedro. Others came from nearby points along the coast.

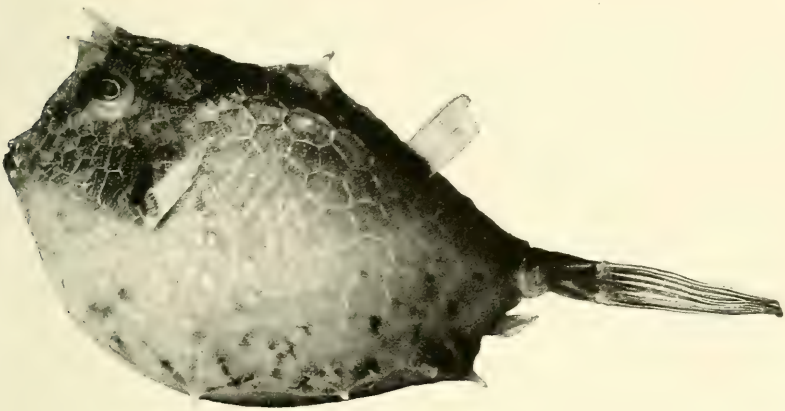


PLATE 4.

Cowfish (*Ostracion diaphanum*) ⅔ natural size.

A NEW LYCAENID FROM SOUTHERN CALIFORNIA

By John A. Comstock and Chris Henne

During the fall of 1928 Comm. and Mrs. Dammers secured in Chino Canyon and Snow Creek, Riverside County, a series of *Philotes* that did not correspond with any of the known races of *P. enoptes,* or *P. battoides.* At the time it was thought to be a giant race of *P. battoides.* Eggs were secured, and bred through to the pupal stage, the results of which will later be published in this Bulletin.

Additional specimens were later secured by the junior author of this paper in 1930 and 1932 at Chino Canyon and Snow Creek, and Mr. M. L. Walton reported it this past year from Box Canyon, Mason Valley, San Diego County.

Through the courtesy of Dr. Foster H. Benjamin, in furnishing notes on the genitalia, which places it as a race of *Philotes enoptes,* we are enabled to offer the following description.

PHILOTES ENOPTES **dammersi,** race nov.

♂ Superior surface.

Primaries: ground color, a rich lustrous blue with a slight violet tinge. The dark marginal band measures .5 mm. exclusive of fringes, is thus considerably wider than in the parent species, and is uniform in its entire length. The nervules show a dark scaling on their outer edges as they approach this marginal band. The fringes are wide, and checkered alternately black and white, the black points concentrating at the ends of the nervules.

Secondaries: ground color as on primaries. Marginal dark band slightly wider in the majority of specimens, and having a scalloped appearance, due to the presence of dark spots or points which are more noticeable near the anal angle, and become less clearly defined as the costal angle is approached. The inner (anal) margin has a grayish or lavender-gray tinge. Costal margin dark. Fringes as on primaries. In three examples there is a slight suggestion of pink on the inner edge of the dark marginal points.

Inferior surface.

Primaries: ground color pale gray. The black spots of this surface are disposed as in the parent species, but are larger, and sub-quadrangular in character. Those of the two submarginal rows have a smeared appearance, (except in the apical region) which is further accented by a dark scaling on the surface between these two rows, which also extends into the basal area along the posterior margin of wing. The appearance is that of a rubbed surface of this portion of the wing, and is more marked in fresh specimens than in those which have lost some of their scales.

The marginal band of small dots is conspicuous and clear.

Secondaries: ground color clear grayish cream. The black spots and points on this surface are smaller, and more rounded than those of the primaries. The submarginal orange lunules are clear and conspicuous, their inner points being tipped with a black dot on their inner margins. The submarginal row of black dots is composed of clearly defined, but relatively small points. With the wide fringes, there is an appearance of a much broader area

between the outer margin and the orange lunules, than in others of this group. The fringes are checkered black and white, as on the primaries, but the black scales are considerably reduced.

♀ Superior surface.

Primaries: ground color, dark gray-brown. Fringes checkered as in ♂.

Secondaries: ground color as in primaries. Fringes as in ♂. A dull orange band extends from a point near the anal angle, to a variable position forward on the margin. In one example this reaches nearly to the costal angle; in another, which shows extreme reduction, the orange extends only to the center of the outer margin. This band is widest at the anal angle, with a scalloped outer margin, and narrows as it extends forward to terminate in more or less detached lunules. In a few examples, the entire band is composed of lunules. A limited number also show a slight blue scaling at the base of the secondaries.

Inferior surface. Very similar to ♂ on both primaries and secondaries, except that the orange lunules average a little larger and show more of a tendency towards confluence.

Expanse. ♂. 19.5 mm. to 26 mm.; average about 21.5 mm. ♀ 17 mm. to 23 mm.; average about 22.5 mm.

Described from 45 ♂, 22 ♀.

Type series as follows:

Holotype ♂ Snow Creek, Riverside Co., Calif., 9-9-32—Chris Henne, Coll.

Allotype ♀ Snow Creek, Riverside Co., Calif., 10-8-32—Chris Henne, Coll.

Paratypes 1 to 16, ♂ ♂ Snow Creek, Riverside Co., Calif., 10-8-32—Chris Henne, Coll.

Paratypes 17 to 24, ♂ ♂ Snow Creek, Riverside Co., Calif., 9-9-32—Chris Henne, Coll.

Paratypes 25 to 29, ♂ ♂ Chino Canyon, Riverside Co., Calif., 10-6-30—Chris Henne, Coll.

Paratypes 30 to 36, ♀ ♀ Snow Creek, Riverside Co., Calif., 10-8-32—Chris Henne, Coll.

Paratypes 37 to 43, ♂ ♂ Snow Creek, Riverside Co., Calif., 10-3-31—Dammers, Coll.

Paratypes 44 to 47, ♂ ♂ Snow Creek, Riverside Co., Calif., 10-19-30—Dammers, Coll.

Paratype 48, ♂ Chino Canyon, Riverside Co., Calif., 9-16-29—Dammers, Coll.

Paratype 49, ♂ Snow Creek, Riverside Co., Calif., 10-7-28—Dammers, Coll.

Paratypes 50 to 51, ♂ ♂ Chino Canyon, Riverside Co., Calif., 9-21-28—Dammers, Coll.

Paratypes 52 to 57, ♀ ♀ Snow Creek, Riverside Co., Calif., 10-3-31—Dammers, Coll.

Paratypes 58 to 64, ♀ ♀ Snow Creek, Riverside Co., Calif., 10-19-30—Dammers, Coll.

Paratype 65, ♀ Snow Creek, Riverside Co., Calif., 10-7-28—Dammers, Coll.

In addition, five ♂ ♂ previously sent the U. S. National Museum are designated Paratypes. These were collectioned, Snow Creek, Riverside County, 9-9-32, Coll. C. Henne.

We have established this rather generous series of Paratypes in order that distribution may be made to the U. S. National Museum, the Canadian Museum at Ottawa, the Los Angeles Museum, the California Academy of Sciences Museum in San Francisco, the Jean Gunder Collection, and the collection of Comm. C. M. Dammers. The holotype and allotype will be placed in the U. S. National Museum.

Dr. Benjamin, in writing us concerning the genitalia of this race states that "It is allied to *enoptes* Bdv., of which it may possibly represent an extreme race, but the lateral prolongation of the harpe is much too long for any of the *enoptes* or *glaucon* group known to me. Superficially it differs from all other species in the group by its bright blue color. It most closely resembles *ancilla* in superficial appearance; but your species, aside from being distinguished by the different shade of blue, has the black markings on the under side of the fore wing heavier and with more black powdering throughout the submedian to inner areas, while the whole ground color on the under side is paler and brighter."

The authors are particularly indebted to Dr. Foster H. Benjamin for his help in pointing out the genitalic relationships of this insect, and to Commander Charles M. Dammers, for placing at our disposal his entire series of specimens. In view of his having first discovered it, we take pleasure in naming it for him.

NOTES ON THE LIFE HISTORIES OF TWO CALIFORNIA LEPIDOPTEROUS INSECTS

By John A. Comstock and Charles M. Dammers

Basilarchia obsoleta Edw.

For the past several years we have beeen endeavoring to observe and record the life history of *Basilarchia obsoleta,* and have made numerous trips to the Colorado River with that purpose in mind. On each occasion the species was observed in flight, and was watched with patience and persistence, but to no avail. Females were repeatedly trailed from tree to tree, through the thickets of willow and cottonwood, in the hope that one might choose to oviposit within reach, but the high flight of the butterfly and the density of growth in the river bottoms defeated our aims.

This past fall the authors again made their pilgrimage to Blythe, reaching there on September 24. We were outfitted with field breeding cages, long-handled clippers, numerous breeding boxes, extension nets, and all other requisite paraphernalia.

A fine female was soon captured, and housed in a tall and roomy breeding cage, with fresh young willow. A sugared bag was placed in the cage, which she soon located and fed upon. She seemed quite at home, and strolled about leisurely over the willow and side walls of the enclosure, but not one egg would she lay.

On the morning of the 25th we began our customary neck-craning for signs of the larvae, but not one was to be seen, though the females were plentiful and the flight seemed to be at its height.

By chance, the junior author was casually looking over some low hanging willow branches when he suddenly spied a full grown *Basilarchia* larva. Thereafter we ceased to scan the topmost portions of the trees, and searched within reach. Our efforts were rewarded with four mature larvae and one chrysalis.

Another fortunate discovery was later made which resulted in our collecting over a hundred eggs, and numerous larvae in various stages of development.

A large female started its flight across the flats of the river, seemingly intent on reaching Arizona. After it, in hot pursuit (over 100 Fahrenheit) sped the junior author. At the water's edge was a small patch of newly seeded cottonwood and willow, growing about knee high. Here the butterfly stopped, and leisurely proceeded to oviposit. Soon we discovered that she was not alone. All about her were equally busy females, engaged with their selection of tender leafy tips, and quite unmindful of the excited lepidopterists.

Here we observed the peculiar habit which the female has of alighting on the upper surface of a leaf, which bends down with her weight. She then slides down the surface, tail first, until the tip of her abdomen is exactly in contact with the tip of the leaf. At that point she deposits her egg.

A single female would oviposit indiscriminately on cottonwood or willow. Oviposition began each morning at about 8:30 and ceased at 11 o'clock A. M., when the females would seek the cover of the larger groves on the river terraces.

One chrysalis was located and observed in the act of hatching. It proved to be a female, which, before her wings were dry, was found by a male, and copulation immediately occurred. Our observation with this, and many other species, leads to the conclusion that mating frequently takes place in a state of nature before the females have been in flight, or their wings have hardened.

The habits of *Basilarchia obsoleta,* throughout its life cycle, are evidently quite similar to those recorded by several authors for *B. archippus,* its eastern relative. The species evidently has at least three broods in this area, and perhaps four, the last one being abortive. These broods overlap to a considerable extent, which makes it possible to find examples in practically all seasons except mid-winter. We have freshly emerged examples taken in April, May, June, September, October, November, and a few in December. The December examples were bred from larvae of the last brood, only a few of which emerged, while the majority hibernated as young larvae. No collecting has been done in February, or March, hence records are lacking for those months.

Dr. Holland and W. G. Wright have both, unfortunately, omitted reference to the occurrence of this species in California. Its range in this state is throughout the Colorado River basin, wherever cottonwood and willow occur. Irrigation in the Imperial Valley has extended this range considerably by the introduction of willow along the canals and ditches. It extends, also, as far to the northwest as Mason Valley, San Diego County.

EGG. Glistening green: subspherical, with a flattened base, and similar in form and texture to that of other members of the genus. It is, however, slightly taller, proportionately, than the egg of *B. lorquini,* and the micropyle is less clearly defined.

The surface is covered with a series of raised walls, enclosing depressed hexagonal cells. At the juncture of each cell wall a single sharp spine arises.

SIZE: 1.3 mm. broad by 1.5 high. Base flat. Top, more acutely rounded than the egg of *B. lorquini.* Micropyle, barely perceptible, small, with the floor marked by minute cells.

The walls of the cells previously noted, and also the spines, are a lighter green than the body of the egg, and are translucent.

As the time of emergence approaches, the egg assumes a light russet shade. The average span of time, from laying to emergence of larva, is 8 days. The eggs are heavily parasitized by a minute Trichogrammid wasp. (Probably *T. minutum.*)

The egg is illustrated on Plate 5, fig. *a.*

a.

b.

c.

PLATE 5.

Egg, larva and pupa of *Basilarchia obsoleta.*

a. Egg, magnified x 20. *b.* Mature larva, enlarged x 2.
c. Pupa, enlarged x 2.

LARVA, FIRST INSTAR.

Length, when newly emerged, 3.1 mm.

Color of body a dark mottled olive green, or greenish yellow. Head, yellow brown, and larger than any of the body segments. After 24 hours the body assumes a browner shade, slightly lighter in color than the head.

Body cylindrical, tapering slightly from the first segment to the caudal end.

A series of paired papilliform nodules is present, placed dorso-laterally and extending longitudinally the length of the body. Those on the 2nd, 3rd, 5th and 11th segments are largest, while the same points on the 10th segment are barely perceptible. On the remaining segments there are mere vestiges of these papillae. The larger nodules are tipped with dark brown points.

Another series of nodules, running longitudinally, is placed laterally, and a third series runs supra-stigmatally. These are very small as compared to the series first described.

The infrastigmatal fold is pale buff, and bears a few hairs which incline downward.

The surface of the body is slightly rugose, with small nodules arranged in transverse rows. These are lighter in color than the body, and some of them are tipped with minute colorless hairs. Higher magnification discloses a surface thickly sprinkled with minute dark brown punctae on a lighter ground color.

The abdomen is concolorous with the body.

Spiracles, practically indistinguishable, and concolorous with the body surface.

Legs, blackish brown. Prolegs and anal prolegs, brown.

The head bears a few scattered light hairs, and is not pappillated as in later instars. Mouth parts tipped with dark brown. Ocelli, brownish black. A narrow dark brown line marks the juncture of head with first thoracic segment.

Duration of first instar, 5 days.

SECOND INSTAR (24 hours after first moult).

Length, 4.5 mm. General coloration much darker than in previous instar, with a sprinkling of numerous light tan tubercles.

There is a saddle of soiled white which begins on the dorsum at about the middle of the 7th segment and extends posteriorly to the edge of the 9th. A series of paired warty tubercles extends in a longitudinal line on each side of the median line, from the 2nd to the caudal segments. The ground color of these is rich brown, and each one bears a number of secondary papillae of a light tan or cream shade which gives them an encrusted appearance. Those on the 2nd and 11th segments are largest, and next in size are those of the 3rd and 5th. A large pair of these encrusted tubercles occurs on the anal segment, which rests on a light tan base that is sprinkled with lighter punctae.

Two additional rows of tubercles occur along the side of the larva, one placed supra-stigmatally, the other midway between it and the first described row. The latter rows are of the same general character, but the tubercles are smaller.

The entire body is heavily sprinkled with small light papillae or punctae, which stand out in strong contrast to the blackish brown ground color, giving the larva a peppered appearance.

The head is also thickly covered with the same character of nodules, those in the center being concolorous with the ground color, while those on the outer margin are light tan or cream.

Ocelli, jet black. Mouth parts, blackish brown.

Abdomen, same as body. Stigmata, black or brownish black. Infra-stigmatal fold or overlap, buff. Legs and prolegs, brownish black.

On higher magnification, the warty papillae covering the surface of the body are seen to be tipped with very short single hairs.

Duration of instar, 3 to 4 days.

THIRD INSTAR (24 hours after 2nd moult).

Length, 17 mm.

The shape and coloration are similar to the last phase except that the protuberances are enlarged, particularly those on the caudal end, which have lengthened posteriorly to produce the effect of a double tail. The general color effect is darker, with the raised points a dark brown, and suggestions of a dark gray at the segmental joints. The subdorsal projections on the 2nd segment are joined by a raised white bar. The saddle is almost white, and is more prominent. The overlap on the 10th and 11th segments is white, and this light patch is carried across the abdomen. There are two projections on the crest of the head.

The duration of this moult was not recorded, as the greater number of our larvae went into hibernation at this point, and those which fed through to maturity were not observed in the actual process of moulting.

FOURTH INSTAR.

Average length, 27 mm.

Ground color of body, gray, which shows only at the segmental joints, being elsewhere obscured by numerous pale and dark brown spots, or by characteristic markings as below described.

The first segment is gray, speckled with black and brown. The 2nd and 3rd are buff. These two latter protrude prominently at the side. The remainder of the body except the saddle mark is mottled with shades varying from pale olive to dark brown.

In the centre of each typical segment, arranged in transverse rows, are a number of raised brown nodules, with steel blue points or crests. Posterior to the 6th, 7th and 9th spiracles there are black patches.

On top of the 2nd segment there are a pair of long curved horns, as in other members of the genus. These are covered with glistening dark brown conical warts, having orange tips, each of which terminates in a minute colorless hair.

On the upper part of the 3rd, and also the 5th segments, are paired raised nodular areas, bearing stellate tubercles at their tips. The pair on the 3rd segment have a white bar which joins them across the dorsum. The pair on the 5th segment are larger.

On the 10th and 11th segments there are paired nodules of similar character to those just described. The caudal protrusions are prominent, and are encrusted with dark brown conical tubercles.

The soiled white saddle extends over the whole of the 8th segment down to the overlap, and is protruded forward on the 7th as a wide dorsal band, then narrows and extends over the 6th segment. It also extends caudally over the 9th segment. The overlap (infra-stigmatal fold) is brown on the first three segments, and then white along the remainder.

Abdomen, gray-olive with a brown bar across each segment, except the 10th and 11th, which are a soiled white.

Stagmata gray, with black rims.

Legs, pale brown. Prolegs, and anal prolegs, pale brown, with white claspers.

Head, pale chestnut, covered with many minute raised points. A pair of short horns project upward from the crest. Ocelli and mouth parts, black. Under higher magnification the body is seen to be sparingly covered with minute colorless pile.

MATURE LARVA.

Length, average 33 mm.

There are two color phases of this stage. One is predominantly gray, with brown or olive brown markings, which is sufficiently close to the last described instar to need no further description. The other is apple-green. This green form will be here described in detail.

Body color, apple-green, heavily overlaid in certain areas with white.

First segment constricted, white, slightly mottled with light green. Two transverse creases across the dorsum result in 3 ridges or folds, giving flexibility to the segment. The spiracle of this segment is large, oval, with gray center and black rim.

Second segment, larger than any of the others, and protruded dorsally into a prominent ridge. This entire segment is white, and from its upper lateral aspect a prominent long horn arises on each side. This horn measures 6 mm. from base to tip. It is covered with numerous papilliform nodules, the tips of which are white while the remainder of the nodule is dark brownish green of the same shade as the main body of the horn. These horns arise at right angles to the body, but have a slight backward arch in their proximal half, and a forward arching in their distal portion. From each papillus there arises a short single hair.

The third thoracic segment resembles the second, but is less prominent, and is slightly mottled with light green. At the points corresponding to the positions of the prominent horns of the second segment there are two warty rugose prominences, one on each side, which are pure white.

The fourth segment is less pronounced than the third or fifth, and is regularly mottled green and white. It is thrown into three regular folds, the anterior one composing the first half of the segment, the posterior being very narrow. This segment bears a number of regularly disposed shining blue tubercles, disposed as shown in the illustration.

The fifth segment is more prominent than the fourth, on account of two large tubercles, (one each side of the median line). These are yellowish in color and smooth in texture, and are topped by a rugose white bunch of papillae, each point of which bears a minute hair.

On the dorsal surface of these large tubercles there is a depression, anterior and posterior to which are paired protruding small blue tubercles, similar to those on the fourth segment. Another pair of the same blue tubercles occurs above the stigmata. The larger of the last mentioned tubercles is immediately above the spiracles, while the second is slightly postero-superior to it. Similar paired blue tubercles occur in the sixth, seventh, ninth and tenth segments.

On the seventh, eighth and ninth segments there is a prominent white saddle-shaped area, which dips laterally over the eighth segment to become confluent with a prominent infra-stigmatal white longitudinal line or fold, the lower edge of which is the "overlap." There are a few green points and dashes in the mid-dorsal area of these three segments.

The sixth segment has a slight repetition of the yellow tubercles which are so prominent a feature of the fifth, but these are very much reduced in scale, and the warty white excrescences topping them are likewise much smaller. Six blue tubercles also occur on the dorsal surface of this segment, two being paired anteriorly and four (smaller) located in line posteriorly to the center of the segment.

The seventh segment shows a trace of the warty white excrescences arising directly from the surface of the segment, but there are no dorsally placed blue tubercles.

The eighth segment is free of all tubercles or excrescences, and is, as previously stated, almost a solid white.

The ninth segment is also free of tubercles on its dorsal aspect. Laterally this segment has a large mottled green patch, which extends caudally to the tip of the tail.

The tenth segment bears yellowish tubercles on its dorsal aspect corresponding in size and position to those on the sixth, and topped by the same series of warty white excrescences. This segment differs from the others in having three pairs of blue tuberclues in the mid-dorsal area: a pair above each spiracle, and a series of three placed transversely in line postero-superior to the spiracle. This segment is a mottled green except on the infra stigmatal fold.

The eleventh segment bears yellow tubercles similar to those on the tenth, except that the warty white excrescences on their tips are larger and more prominent than any other in the series.

The anal segment has two rugose protuberances, one each side of the median line. These are dark green.

Legs, yellowish, tipped with blackish brown. Prolegs, yellowish-green with brown claspers.

Head, bilobed, heavily papillated. Suture deeply depressed, light above, brown as it approaches the clypeus. The face next to the suture is white, with a few green points in the upper portion. A bluish green band extends down the middle of the cheek, gradually being replaced by white on the outer edge. Clypeus, greenish white. Two large horn-like warts protrude on the upper angle of the head, one topping each lobe. These are heavily rugose and are darker green than the remainder of the head. Each cheek also bears five smaller warts of somewhat similar character. The outer circumference of the head is edged with a series of pointed white tubercles, each one of which is tipped with a minute short hair. Mouth parts brown. Ocelli, brownish-black, the three anterior ones on an olive field.

The mature larva is illustrated on Plate 5, fig. *b*.

PUPA.

Length, 24 mm. Greatest width through thorax, 9.5 mm. Depth through line of center of "hump," 11 mm.

The general color is a mottled dirty white and brownish green. The wing cases and head are wood brown with a slight olive tint. The dorsum of the thorax is a mottled tan. The dorsal hump is dark brown, lighter along its posterior surface, with a slight suggestion of gilding at its base.

The cremaster and caudal segments are a dark brown, and the abdominal segments, soiled white. The wing cases and hump are heavily rugose, and the entire surface has a glistening sheen. The form is characteristic of the genus, and is accurately pictured in Plate 5, fig. *c*. Ten days elapsed from the formation of chrysalis to emergence of imago.

In the three first instars, the larva has the habit of partially curving its body toward the side. In this resting attitude it resembles, both in form, and color, a dried bird excrement. The adult larva also simulates a fresh bird dropping.

In general habits of feeding, resting, movements, construction of the hibernaculun, etc., it very closely approximates the larva of *Basilarchia archippus,* as recorded by Scudder and others.

An egg which was laid September 25 was carried through to maturity and the imago emerged November 17. This was of the late fall brood from which the majority of the larvae hibernated.

Two others of this brood pupated on the 8th and 17th of January, respectively, and imagos are recorded as emerging on January 9, February 4 and 5. As the latter were reared under artificial conditions varying from those in a state of nature it can hardly be assumed that a mid-winter brood may be expected.

THOLERIA REVERSALIS Guen.

This large Pyralid has been causing considerable damage to Genista (broom) in the gardens and parks of Southern California during the past three years. The moth seems to be a late introduction in this district. It is unusually free from parasitic attack, and its presence in ever increasing numbers presents a menace which will require careful consideration of the economic entomologist in bringing about biologic control. A partial record of its life history is here presented, as an aid toward that end.

EGG.

Size, approximately 1 mm. long by .75 mm. wide, and probably not more than .2 mm. thick. Oval, flat. Color, yellowish, when first laid. The eggs are deposited in a thin sheet, in regular rows, each egg overlapping its neighbor, and each row overlapping. Eggs are deposited in nature on the under or upper surfaces of the leaf, but in captivity they are laid indiscriminately in patches about the breeding cages. The mass resembles a series of shingled scales.

With higher magnification the surface of the egg shows a delicate reticulation, which is probably responsible for the pearly lustre which is seen over it in certain angles.

As the embryo develop they can be clearly discerned through the transparent shell, as recurved hyaline bodies. Eventually they fill the egg. Shortly before emergence two small brown spots become apparent near or on the head of the embryo.

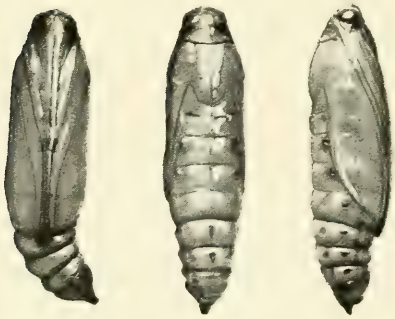
A group of eggs is shown on Plate 6, fig. *a*.

During the early part of their development the young larvae are gregarious, and as they feed a loose webbing is spun, which, together with the defoliation or partial defoliation of the terminal branch on which they are feeding makes the colony fairly conspicuous. This webbing is not sufficiently dense to be designated a "tent," and the young caterpillars are always discernible.

As the larvae grow larger, they separate and become solitary.

a.

b.



c.

PLATE 6.

Eggs, larva and pupa of *Tholeria reversalis*.

a. Egg mass, magnified x 6. *b*. Mature larva, enlarged x 2.

c. Pupa, enlarged x 3.

MATURE LARVA. Length, average, 28 mm.

Head, glistening black with occasional yellow patches in front, and covered sparsely with long white hairs. Labrum, greenish yellow. All other mouth parts and appendages black. Ocelli, black.

Body, ground color yellow, or in some examples olive-yellow. Scutellum, gray-white, with quadrate white spots superimposed on it.

A series of three papillae, grouped together, occur suprastigmatally on each segment, two of which are in line transversely, and the third placed immediately posterior to this pair. These papillae have black centers, and white points at their upper and lower edges, and each papillus bears a long white hair.

A series of bright lemon-yellow dots runs longitudinally along the side of the body immediately below the stigmata, and inferior to this on each segment (except the first three and caudal) there is a white crescentic dash. This gives to the overlap an appearance of a broken white dash. Each one of these crescentic spots has, in its center, a small black point or dash, from which arises a pair of white hairs. Below the overlap on each segment are additional raised black spots (2 or more to a segment), with white lower edges, from which are given off the same type of long white hairs.

Abdomen, dull lemon-yellow. Legs, black. Prolegs and anal prolegs, black and white, with brown claspers. Stigmata, black. Illustrated on Plate 6, fig. *b*.

The caterpillars usually leave the bushes to pupate, when not confined. They may crawl considerable distances, and seek small cracks about window casings. Specimens have, in this way, emerged in dwellings; and caused the owners considerable concern. Their cocoons are frequently found under fence railings, and about the eaves of buildings.

The cocoon is white, and somewhat loosely woven.

PUPA. 12 to 14 mm. long. Cylindrical.

Color, yellow-brown, with the segmental junctures clearly defined as narrow brown lines. The surface is entirely free of hirsute appendages, except for the cremasteric vibrissae.

A poorly defined mid-dorsal line is present; otherwise there are no discernible markings. The chrysalis is shown on Plate 6, fig. *c*.

Considering the abundance of larva, it is surprising to find such a small percentage of imagos coming to light. The species is at least double brooded in this section, and is widely distributed in southern California.

GEORGE WHITWELL PARSONS

In the passing of George Whitwell Parsons, who died in Los Angeles on the 5th of January, 1933, the Academy of Sciences loses another of its pioneer members. From its founding in 1891 as the Southern California Science Association, Mr. Parsons had served as Chairman of its Geological Section, and since July, 1909 as a member of its Board of Directors. A continuous, friendly association of forty-two years in the pursuit of scientific knowledge is broken, with many pangs of regret and sorrow on the part of his colleagues. Mr. Parsons, in his unselfish devotion to the cause and long service, was typical of a line of noble characters who preceded him to the great Beyond, including Dr. M. A. Alter, the first President; Prof. Wm. H. Knight, Mrs. Mary E. Hart, the first Secretary; Abbot Kinney, Prof. W. L. Watts, John D. Hooker, Dr. Anstruther Davidson, Arthur Benton, S. J. Keese, Holdridge O. Collins, and others who served on the directorate and in administrative offices.

George Whitwell Parsons was born in the District of Columbia in 1851. At the age of twenty-five, in 1876, he migrated to the Pacific coast, going to San Francisco by the Panama route. From there he shortly removed to Tombstone, Arizona, which, owing to the recent discoveries of Ed. Sheffelin, was enjoying its first boom, and was the great center of mining interest. There he found a fertile field for a geologist, and developed an interest in mining and mineralogy which he held through life. He was an authority on the early history of Tombstone and the early development of Arizona. It was his custom to return to Tombstone each year for its annual celebration, and renew, so far as possible, the associations of his earlier days. Recently he contemplated writing a book to preserve his memories of those strenuous times, but this task was postponed too long.

About the year 1890 Mr. Parsons took up his residence in Los Angeles, and remained here uninterruptedly until his death. Here he practiced his profession and acquired business interests which fully occupied him. He was one of the organizers of the Chamber of Commerce, and acted for years as Chairman of its Mining Division. While serving in that capacity he started a movement for the erection of signs on the Colorado desert, directing wayfarers to available waterholes. This compaign required several years of strenuous effort and numerous journeys to Sacramento and Washington to secure necessary legislation, but it was finally successful. The desert signs have been in place for the past ten or twelve years, and there is no telling how much suffering and how many lives they have saved. Probably Mr. Parsons found more satisfaction from this than from any other achievement of his life.

Mr. Parsons was one of a family of two sons and two daughters, none of whom ever married. The late Alice Parsons, a sister, was the founder of a private school for girls in Brooklyn, N. Y. Later she removed to this county and established the Girls' Col-

legiate School at Glendora. The late Samuel Parsons, for thirty years auditor of the Citizens' National Trust and Savings Bank and branches, was a brother. The only surviving member of the family is Miss Emma Parsons.

For the past two years Mr. Parsons had made his home with Mr. and Mrs. John Chard at 1140 West Adams Street, Los Angeles. Less than a week before his demise Mr. Parsons developed symptoms of heart ailment, but he was not completely prostrated, and he and his friends were not seriously alarmed about his condition. He was sitting in the sun room attended by his friends when death summoned him.

Funeral services were held at St. Paul's Cathedral, presided over by Bishop William B. Stevens, and the interment was at Evergreen Cemetery, with ceremonies conducted by Dr. Henry Beal, Dean of the Cathedral.

An excellent likeness of Mr. Parsons is reproduced in Vol. 18, page 28 of the Bulletin So. Calif. Academy of Sciences.

W. A. Spalding.

WILHELM SCHRADER

The passing of Mr. Wilhelm Schrader, on October 8, 1932, removes from the ranks of the Academy another of its benefactors.

Mr. Schrader was in many respects a unique personality. Possessing the instincts and inclinations of a scientist, yet lacking the opportunity of acquiring the technical training, and with a supersensitive nature that made contacts with contemporaries exceedingly difficult, he became a recluse. Thus the work which he carried on for years resulted in much duplication of the experiments of others. At the same time, his extreme patience, and solitary concentration, resulted in certain helpful results that give us a better understanding of the influences of selective breeding and atmospheric variation, on the modification of insect life. His papers, published in the Pomona College Journal of Entomology, Vol. 4, pp. 673 and 801; and Bulletin, Southern California Academy of Sciences, Vol. 25, p. 77; Vol. 27, p. 69; Vol. 28, pp. 8 and 20, speak for themselves.

Mr. Schrader had no relatives or descendants. He left no record of his early life, and it is only known that his full name was Ernest Carl Wilhelm Schrader, and that he was born in Zellerfeld, Germany, December 21, 1865. He was employed for some time in Los Angeles as a gardener. With his simple tastes and frugal living, he accumulated a small estate. His native good judgment asserted itself several years ago when he arranged with the late Samuel J. Keese, to place this estate, or at least the major

part of it, in a trust, of which the Southern California Academy of Sciences was the beneficiary, but in which he (Mr. Schrader) retained a life interest. Thus his assets were carefully conserved, and he was paid the income from the estate during his lifetime.

In the later months of 1932 Mr. Schrader became morose, having been in poor health for some years. He left a note, expressing the fear that his mind was giving way, and not wishing to be a burden on the community, he had decided to end his life. Thus, in a characteristically methodical way, not at all suggestive of mental lapse, he placed his "house in order," and ended his life by inhaling gas.

The work of disseminating scientific knowledge, in which he was so greatly interested, will carry on into the future, aided by the trust which he established. How much greater is this contribution to society, than is the pyramiding of vast personal fortunes by short-sighted individuals—many of whom have witnessed in these times the crumbling of their financial castles without the salvage of a single item as a contribution to social advancement.

The work of the Southern California Academy of Sciences is carried on entirely through the generosity of private citizens, who are sufficiently interested in the advancement of education and cultural endeavor to donate funds or make bequests to the Academy. As a guide, in the matter of bequests, for those who plan to further this program, the following forms are suggested:

Form of Legacy

To be used when it is desired to leave the Academy any personal property, such as money, stocks, bonds, works of art, or other objects of value.

I give and bequeath unto "Southern California Academy of Sciences," of the City of Los Angeles, the sum of..... Dollars: To have and possess the same unto the said "Southern California Academy of Sciences," its successors and assigns, to the uses, dispositions and benefits thereof forever.

Form of Devise

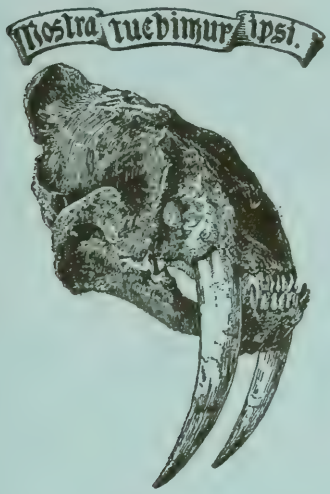
To be used when it is desired to leave real estate to the Academy.

I give and devise to "Southern California Academy of Sciences" of the City of Los Angeles, (..... here describe the property or ground rent.....), together with the appurtenances, in fee simple, and all policies of insurance covering said premises, whether fire, title or otherwise, free from all taxes: To have and to hold the same unto the said "Southern California Academy of Sciences," its successors or assigns forever.

BULLETIN OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA



Vol. XXXII May - August, 1933 Part 2.

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Issued June 20, 1933

Southern California Academy of Sciences

OFFICE OF THE ACADEMY

Los Angeles Museum, Exposition Park,
Los Angeles, Cal.

ITEMS OF INTEREST FROM MISCELLANEOUS NEO-BABYLONIAN DOCUMENTS

By Carl Sumner Knopf, B.D., Ph.D., F.P.G.S.
(Professor of Semitic Archaeology and History, University of Southern California)

Foreword

There is considerable interest today in the field of archaeology. The discovery of the tomb of Tut-ankh-amen fired popular imagination and the subsequent finds at ancient Ur made Queen Shub-Ad an intimate friend. Pictorial supplements have familiarized faces, jewelry, utensils, living quarters, and the little vanities of ancient life.

After the first passing phases of curiosity, there always remain the more permanent items that add to historical knowledge or that permit reconstruction of the culture of the past. In addition to specialists, there is a large group of serious minded folk who like, as it were, to clasp hands with real persons in that ancient world. It is one thing to read about an historical character; it is another to hold in hand some bit of evidence of that character's living, breathing humanity.

Through the generosity of Mr. M. M. Welch, whose interest in the permanent values of life is unflagging, the University of Southern California has become the depository of a fine collection of Neo-Babylonian documents. These documents, about 600 in all, combined with the small collection owned by the writer, furnish a considerable field for research.

A special seminar room has been assigned in the Doheny Memorial Library for exhibition and work upon these tablets. The exhibits meet the more popular interest, showing legal documents, business forms, private correspondence, historical data and Biblical items.

About 200 of the tablets have been translated and will be published in due time. Work upon the remaining tablets will continue. In the meantime, it has been thought fitting to present several items that may have more than usual significance. *At present, no conclusive statement should be made and the final decision on many problems can come only after scholars throughout the world have had a chance to study and criticize.*

It is in this spirit that the present monograph goes forth. The writer has tried to guard suggestions and avoid dogmatism or finality. Additional evidence may even now be in the hands of scholars that will refute or support some of the ideas advanced. It is highly desirable that such evidence be called forth. Only by comparison and friendly exchange between workers in the field can ultimate truth be established.

One or two items have been included that may be of secondary interest or value to specialists. In the very nature of the case, members of the Southern California Academy of Sciences are entitled to some pleasure and profit in the reading of their bulletins, which must combine technical discussion with style of presentation that will enable scientists of different fields to enter into an appreciation of each other's work.

Some of this material is an abridged form of a dissertation presented to the faculty of the Graduate School of Yale University in candidacy for the degree of Doctor of Philosophy. Subsequently, through the courtesy of the British Museum and the Yale Babylonian Collection, additional work was carried on in London and New Haven. The writer held personal consultation with Drs. Edward Chiera and Arno Poebel of the Oriental Institute of the University of Chicago; Messrs. Sidney Smith and C. J. Gadd of the British Museum; and Drs. C. C. Torrey, R. P. Dougherty and F. J. Stephens of Yale, on the advisability of publishing certain of these tablets and advancing possible interpretations of the data. Though not unanimous, the majority favored such presentation and it is with that encouragement and the desire to see some of these points threshed out that this bulletin is issued.

Special credit is due Dr. R. P. Dougherty of the Yale Babylonian Collection for his patient and constructive criticism; to Drs. John A. Comstock and R. H. Swift for their interest, and to the Academy itself for making this publication possible.

Notes for the Non-technical Reader

The numbers used to designate documents indicate where the originals may be found—e.g. SC 1, Univ. of So. Calif. collection No. 1; CSK 1, Knopf private collection, No. 1.

A caret indicates long vowel, e.g. *î* like *"ī"* in machine. Other diacritical marks are *š*, pronounced *"sh"*; *ṣ*, pronounced *"ts"*; *ḫ*,

pronounced like a German *"ch"*; *ṭ*, a hard dental, no exact English equivalent. The apostrophe, ', is used to indicate Semitic letter *âleph*, a guttural pronounced according to the vowel that accompanies it. Thus to English readers *'id* would be pronounced *"id."*

It is customary to write determinatives and certain other auxiliary particles slightly above the lines:

âl, a form of *âlu*, meaning "city of" placed before city names.

amêl, before officials and names of professions.

d, represents classical Sumerian DINGIR, "god" placed before names of deities.

kam, follows an ordinal number; e.g. 2^{kam} = 2d.

ki, classical Sumerian *KI*, "place" following geographical names.

m, placed before personal names.

meš, sign of the plural, postpositive.

Broken lines on tablets are indicated by . . . .

Gur, *pi* and *qa* are measures of grain; shekel and mana are measures of weight, but later became also money terms.

a/š stands for *apil-šu ša*, "son of." (Lit. son-his of.)

Belshazzar and His Father

The name of Belshazzar is recognized far beyond the limits of the local Bible class. Hebrew sources would indicate that the administration of government was in his hands. The term "king" is applied to him in the book of Daniel, but with the gradual unearthing of Babylonian history, it has seemed to some that this designation of Belshazzar might be a misnomer and a Biblical writer's literary device to enhance his story.

In 1929, Dr. R. P. Dougherty of Yale University published his volume on *Nabonidus and Belshazzar*, on p. 96-f of which he called attention to a certain oath formula that appeared on tablets of Nabonidus' reign. This involved swearing "by (certain deities) and the laws of Nabonidus, king of Babylon, and Belshazzar, son of the king." In no other period or with no other two rulers is this coördination found. It is an exclusive feature of Nabonidus' reign. Ordinarily an oath was taken in the name of the gods and the king only. Evidently Belshazzar was in a unique position in relation to the exercise of kingship.

Nabonidus, as is now known, was somewhat of an antiquarian, interested in digging for temple foundations and ancient records in addition to running a government. Also, he spent considerable time at Têmâ in Arabia which, though now an unexcavated mound immediately south of modern Teima, was probably a residential spot of beauty on the southern Nile-to-Euphrates caravan route. The Nabonidus Chronicle indicates that he was in Têmâ in the 7th, 9th, 10th and 11th years of his reign.

Dr. Dougherty, in the volume mentioned above, p. 96, and Mr. Theophilus G. Pinches (Proceedings of the Society of Biblical Archaeology, Jan. 1926, p. 27; pl. I) found texts with the Nabonidus-Belshazzar oath formula, written in the 12th year, and Dougherty stated that "doubtless Neo-Babylonian contract tablets with similar oath formulae dated in other years of Nabonidus' reign will come to light." Text SC 119 confirms this statement and adds evidence concerning the relations between the king and his son.

The tablet, 1⅝″ x 2¼″, light color, originally unbaked, is badly broken and the broken sections involve important elements, but fortunately some of these elements are traceable or can be restored. For instance the very name, Belshazzar, is broken away, but the sentence *^{md}Nabû-nâ'id sar Bâbilî^{ki} ù ..... mâr šarri,* "Nabonidus, king of Babylon and ..... son of the king," appearing in an oath formula leaves little doubt as to the person referred to, especially since the same phrase has appeared in other tablets. Any such association of Nabonidus' other son, Nebuchadrezzar,[1] in governmental administration does not seem likely.

At the end of line three, *a* is followed by a break, but fits exactly what would be expected as the initial sign of *a-di-e,* "laws," in an oath formula, while line seven supplies the *it-ti-me ki-i,* "swore as follows," to complete the idiom. The tablet, then, records the oath of *Ina-eshî-êṭir,* who swore by the goddess of Erech, Nanâ, and the laws of the king AND HIS SON.

By a fortunate coincidence, though the date formula is badly mutilated, the year of reign is clearly preserved, being the seventh of Nabonidus. The other tablets containing this unusual oath formula were written in the twelfth year, *after* the Têmâ sojourn had become a recognized royal procedure, but SC 119 shows that the dual administration was established as early as the first known residence of Nabonidus at Têmâ. It was not something forced or

---

[1] Not Nebuchadrezzar the Great, 605-562 B. C.

growing out of his practice of absenting himself from Babylon, but was part of a deliberate organization of government that provided dual responsibility and authority. Neither was the investiture of Belshazzar a paternal gesture safeguarded by the king's immediate presence. There is no evidence that he was in Babylon in the twelfth year, nor can it be asserted that he was in Arabia in that year, but it is certain that he was out in Têmâ in the seventh year in the ninth month of which this tablet was written.

Belshazzar's position, then, was one of actual authority, exercised especially while the king was far away from the center of government. He was invested with the *šarrûtam,* "kingship," and legal documents recognized this status. When *Ina-eshî-êṭir* took his oath he little realized that the chance preservation of the ritual formula would be of far more concern than his personal affairs, and that light would thus be thrown upon a minute portion of a great literature, the Bible, which in his day did not even exist.

The writer of Daniel V, concerned with the fall of Babylon and the exaltation of righteousness, naturally found in Belshazzar a character far better suited to his theme than the pious Nabonidus. Belshazzar gave the perfect stage setting for a drama of divine retribution. The author called him "king," *šarru.* "Kingship," *šarrûtam,* he did exercise and the tradition is quite in line with what now appears to be the facts.

TEXT SC 119—RECORD OF OATH

1 ^{m}*Ina-ešî-êtir apil-šu ša* ^{md}*Na-na-a* .... 2*ša* ^{amêl}*ši-ra-ku ša* ^{d}*Bêlit ša Uruk*^{ki} (*i-na*) 3 ^{d}*Bêlit ša Uruk*^{ki} ^{d}*Na(-na)-a ú a(-di-e)* 4 ^{md}*Nabû-nâ'id šar Bâbili*^{ki} *ù* ^{md}*(Bêl-šar-uṣur)* 5*mâr šarri a-na* ^{md}*Nabû-šar - uṣur* ^{amêl}*(šaqû šarri)* 6 ^{m}*Gab - bi - ilâni*^{meš} *- šar - uṣur* (^{amêl}*qi-i-pu*) 7*ša É-an-na it-ti-me ki(-i)* .... 8*ša* ^{d}*Bêlit ša Uruk*^{ki} *ma-la* .... *šap-ru-ma* 9*a-na* ^{amêl}*ša-kin ad-di(-in)* .... 10 ^{amêl}*šir-ki ša* ^{d}*Bêlit ša Uruk*^{ki} *ina eli(?)* 11*ša* ^{amêl}*ša-kin iš(-pu-ru)* .... 12*ša* ^{amêl}*ši-rak ma-la e-lat pidni ša* ^{amêl}*ša-kin ša* .... 13 ^{md} *Nabû-nâ'id šar Bâbili*^{ki} *ina Uruk*^{ki} *šat-ra* 14*Napištu-êṭir a-na* ^{d}*Bêlit ša Uruk*^{ki} *i-nam-din.* 15 ^{amêl}*Mu-kin-nu* ^{md}*Marduk-šum-lîšir apil-šu ša* ^{m}*Ri-mut* 16*apil* ^{md}*Bêl-ú-sat* ^{md}....*-napšâti*^{meš} *apil-šu ša* 17 ^{m}*Ardi-*^{d}*Bêl apil* ^{m}*E-gi-bi* ^{md}*In-nin-šum-uṣur* 18*apil-šu ša* ^{m}*Apil-*^{d}*Bêl-da-a-nu apil* ^{md}*Nabû-šar-ḫi-ilâni*^{me} 19 ^{amêl}*dupšar* ^{md}*Nabû-mukîn-apli apil-šu ša* ^{m}*Nu*.... 20 ^{arah}*Kislimu ûmu 6*^{kam} *šattu 7*^{kam}.... 21.... *Bâbili*^{ki} ....

Translation[2]

[1]Ina-eshi-ẽṭir, son of Nanâ .... [2]of the devotees of the goddess of Erech, BY [3]the goddess of Erech, Nanâ, and THE LAWS OF [4]NABONIDUS, KING OF BABYLON AND (BELSHAZZAR) [5]THE SON OF THE KING, unto Nabû-shar-uṣur the chief officer of the king (?) [6]and Gabbi-ilâni-shar-uṣur the governor [7]of Eanna, swore as follows: .... [8]of the goddess of Erech, as much as .... was sent and [9]unto the prefect I gave (it) .... [10]the devotee of the goddess of Erech, in respect to [11]which the prefect sent .... [12]of the devotee(s) as many as there are in addition to the record of the prefect of .... [13]Nabonidus, king of Babylon, are written, [14]Napishtu-ẽṭir unto the goddess of Erech shall give. [15]Witnesses: Marduk-shum-lishir son of Rimût [16]son of Bêl-usat; ....-napshâti son of [17]Ardi-Bêl son of Egibi; Innin-shum-uṣur [18]son of Apil-Bêl-dânu son of Nabû-sharḫi-ilâni [19]Scribe: Nabû-mukîn-apli son of Nu.... [20]Kislev the 6th; 7th year of .... [21].... Babylon ....

The Writing of the Name Artaxerxes

A brief glance at English literature reveals that the standardization of spelling is a late invention. Ancient orthography was no exception and this is especially true of the rendering of proper names, both in the native tongue and in transliteration to other languages. The appearance of Nebuchadnezzar and Nebuchadrezzar (in the English Bible), Nabouchodonosor (Septuagint or Greek Old Testament) and Nabuchodonosor (Vulgate or Latin Bible) all from the old Babylonian *Nabû-kudurri-uṣur* is a case in point. Probably the original owner of the name would recognize none of them, aside from the Babylonian form.

The name of Artaxerxes of Persia is no exception and Babylonian scribes who were writing documents during his lifetime varied the spelling of his name. The usual forms found are:[3]

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[2] As is often the case in translating Babylonian tablets, the document may be mutilated. Furthermore, we do not have all the details of the original transaction hence can not understand vague allusions to items well known by the principals.

[3] See Hilprecht, H. V. and Clay, A. T., *Business Documents of Murashu Sons of Nippur, Dated in the Reign of Artaxerxes I;* Univ. of Pa. Cuneiform Texts, Series A, Vol. IX; Phil. 1898, pp. 50-51. See also Weissbach, F. H., *Die Keilinschriften der Achämeniden*, p. 139, Leipzig, 1911.

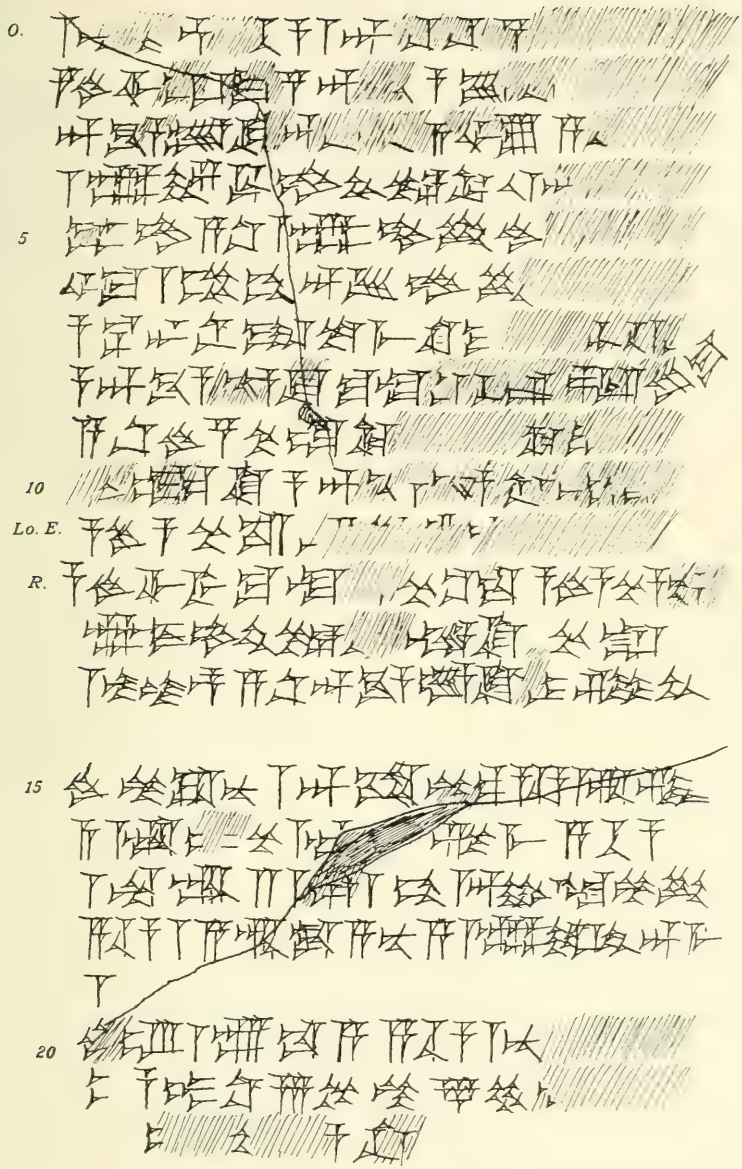

PLATE VII.

Autograph copy of tablet SC 119 containing an oath formula incorporating the names of Belshazzar, and Nabonidus, his father. Father and son shared the rule of Babylon in its closing years.

Ar-táḫ-ša-as	*Ar-táḫ-ša-as-is-su*
Ar-táḫ-ša-as-su	*Ar-tak-ša-as-su*
Ar-táḫ-ša-as-siš	*Ar-tak-šat-su*
Ar-táḫ-ša-as-si-iš	

The finding of one new form will not change the course of history, but in the realm of pure science any datum is its own *raison d'être.*

Text SC 61 is on a tablet 2″ x 2½″ x ¾″ which, when found, must have been badly mutilated. It was probably picked up by some Arab in illicit digging and the finder attempted to "dress" the tablet, scraping and smoothing the mutilated side—a thing the reputable archaeologist would never do. Upon this smooth surface he ruled a few lines but made no attempt to forge cuneiform signs.

The Babylonian scribe made notations aside from the main body of the text, but translation is doubtful. Though well incised, the scribe's writing is hard to read. On the edges three seals appear, probably those of witnesses, whose names were on the mutilated reverse of the tablet. The seals did not contain the names of the owners, so the scribe wrote them in with his stylus in cuneiform.

The chief interest centers in line four where the form *ᵐAš-taḫ-ša-as-su šarru* appears. If the tablet were not mutilated, one could check this with the closing date formula where the king's name would again appear. The usual Persian designation of the king as *šar mâtâti,* "king of countries" would also make certain that the name was none other than that of Artaxerxes. However, where the *KUR-KUR* (*mâtâti*) signs would be expected there is scarcely room for them, and what space there is is perfectly smooth and has had no writing upon it.[4] "The king," rather than "king of countries" was evidently intended.

The initial element in the name as it appears on the tablet is a horizontal wedge. There is only a very remote chance that this is a scribal error for the *ár/ub* sign, No. 261 in Barton's list.[5] Even if so, it would be the only case of the name, Artaxerxes, beginning with this sign rather than with the *ar* sign, No. 408.[6]

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[4] There is an instance of the use of *šarru* alone after the name Artaxerxes on a vase inscription. See Weissbach, *op. cit.*, p. 121.

[5] Barton, Geo. A., *Origin and Development of Babylonian Writing,* in Beiträge zur Assyriologie, Bd. IX, Leipzig, Hinrich's, 1913.

[6] Barton, *op cit.*

It is safer to assume that the scribe wrote just what he intended, and that the reading is *aš*.

By referring to the list of different spellings it is apparent that just as radical philological variations already exist. Where in most cases the surd spirant *ḫ* is used, there are instances where the voiceless guttural mute *k* is substituted. There are two instances[7] where we have *Ar-tak-šat-su*, the third element of the name modified by the substitution of a dental *t* for the dental sibilant *s*.

On SC 61 we find the more common *taḫ* element, but the hitherto undiscovered initial *aš*, substituting the palatal sibilant *s* for the liquid *r*. It is a transition similar to that noted in the Babylonian *Enwaštu* (the deity of the Westland), as reproduced in Aramic endorsements discussed by Clay,[8] for *EN-MAR-TU*.

Considering all these data, it would seem possible to recognize in this form not a scribal error but an actual legitimate variant writing of the name of *Artaxerxes* as *Ashtakshassu*.

This same tablet has several other points of significance. It is a promissory note involving 2½ shekels of silver and the interest rate is 1 shekel per month, 40%, or 480% per annum.[9] The contract itself is very rigid and the whole transaction indicates a story involving some intricacy. In connection with the silver the term *piṣu-ú* "white" is used, probably indicating silver of specified whiteness or standard fineness, much as the modern term "sterling."[10]

The scribe, who is rather careless in making some of the signs, evidently omitted a sign in line five; a word, *ki-i*, "if," at the beginning of line six; and also *šu*, "him," at the end of the word *muḫ-ḫi* in line eight. This can be checked with numerous documents where the standard interest and penalty formula appears.[11]

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[7] Nos. 59:4 and 59:23, recorded by Hilprecht and Clay, *op. cit.*

[8] Clay, A. T., *Amurru the Home of the Northern Semites*. Phila., 1909; pp. 121 and 199.

[9] The exact translation of *pit-qa* is uncertain. It seems to imply some working or fabrication and may be applied to metal or flour. Thus it might suggest fine flour, or moulded metal—pieces convenient for handling in the market place. There are instances where *pit-qa* means ⅛ shekel. If that meaning were applied in this tablet, it would still indicate an interest rate of 5% monthly, 60% per annum, as against the more common 20% rate. On *pit-qa*, cf. Weissbach, F. H., *Zur Keilinschriftlichen Gewichtkunde;* Leipzig, 1912, pp. 3-8.

[10] See Tallqvist, K. L., *Die Sprache der Contracte Nabû-Nâ'ids;* Helsingfors, 1890, p. 116.

[11] Tallqvist, *ibid.*, p. 126; another possible indication of careless writing is the omission of *mâtâti* "countries" after *šarru* "king" in line four.

TEXT SC 61—PROMISSORY NOTE

[1]*2½ šiqlê kaspi 1 šiqil pit-qa piṣu-ú makkûr* [d]*Ištar* [2]*ša qât* [md]*Innina-aḫê*[meš]*-iddin apil* [md]*A-num-aḫ-iddin(-nu)* [3]*ina muḫ-ḫi* [m]*Ḫu-ú-ru apil-šu ša* [md]*Bêl-iddin* [4]*ûmu 2*[kam] *ša* [ara]*Nisanni šattu 11*[kam] [m]*Aš-taḫ-ša-as-su šarru* [5]*kaspa-ám 2½ šiqlê ina qaqqadi-šu i-nam-din* [6]*(ki-i) ina ū-mu a-dan-ni-šu kaspa-ám 2½ šiqlê* [7]*la id-dan-nu ša arḫi ina muḫ-ḫi 1 šiqil pit-qa* [8]*ḫubullu ina muḫ-ḫi(-šu) i-rab-bi*

Lo.E un-qa [m]*Ardi(?)-*[d]*Anum(?)* *un-qa* [m]*Šu?-la-a*

L.E. un-qa [m]*Aḫ?-ê-a (?)*

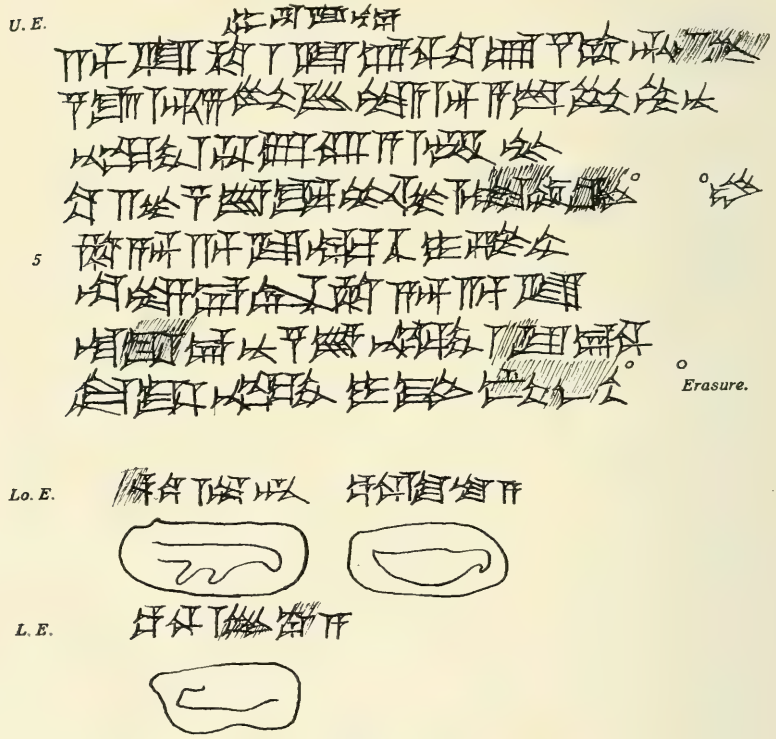

PLATE VIII.

Autograph copy of tablet SC 61, showing badly mutilated but decipherable writing of the name "Artaxerxes."

Translation

[1]2½ shekels of silver in 1 shekel pieces, standard fineness, property of Ishtar [2]entrusted to Innina-aḫê-iddin son of Anum-aḫ-iddinu [3]is to be paid to Ḫûru son of Bêl-iddin. [4]On the 2d day of Nisan, the 11th year of Artaxerxes the king, [5]the silver,

namely 2½ shekels, on the principal he shall pay. [6](If) on the appointed day the silver, namely 2½ shekels [7]he does not pay, monthly upon it a 1 shekel piece [8]as interest against (him) shall accrue.

Seal of Ardi-Anum Seal of Shulâ

Seal of Aḫêa

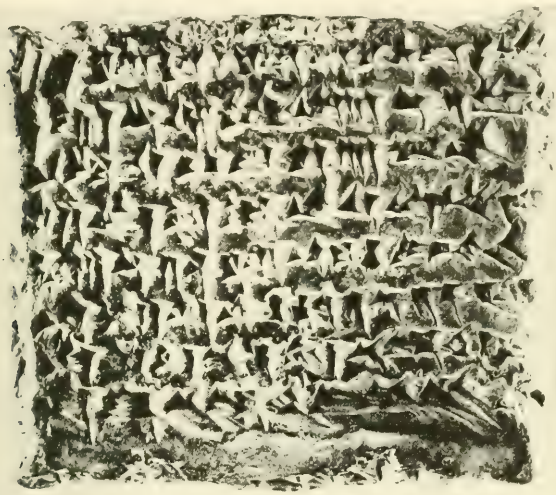

PLATE IX.

Obverse of tablet SC 61. The writing on the other side was scraped off, possibly by some clandestine native digger.

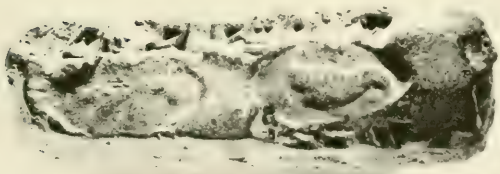

PLATE X.

Seal impressions on lower edge of document. The seals had no names cut in, so the scribe wrote the respective names in cuneiform above the seal impressions.

A Hitherto Undiscovered Designation of a Barylonian Settlement

Two documents, SC 77 and CSK 035, stir interest by the occurrence of a phrase as yet unrecorded by other investigators.[12] Twice in SC 77 and once in CSK 035 reference is made to a city, town, or colony of bondmen,[13] *âlu ša ardâni*^{meš}. Ordinarily this might have raised no inquiry, being considered but an addition to the numerous town names found in the contract tablets. There are references to such settlements of workers, artisans or guilds[14] which may have constituted extensive suburbs of Babylonian cities. But though both documents were executed in the city of bondmen, CSK 035 presents additional data.

This text concerns the payment of 2¼ shekels of silver, royal claim, by Idda son of Ashshia to the steward of Enlil-shar-uṣur. Since it was evidently tax money in charge of the steward and Iddia was to pay it to him, the conjecture is that Bêl-ẽteru-Shamash was permitted to administer his master's funds and make loans. The document involves repayment of such a loan.

On the left edge of the tablet, scratched into the soft clay, is the name of Iddia, written in the West Semitic alphabet such as would be found in Aramaic, Hebrew, Phoenician and related texts. *Le 'Iddi,* "belonging to 'Iddi," or freely, " 'Iddi's document,"[15] is the characteristic scribal notation probably used for convenience in filing. Such notations are often called Aramaic endorsements, though not literally endorsements at all, and as easily made by a Jewish clerk as by an Aramean.[16]

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[12] Dr. Chiera found no reference to it (June 1932) in the files of the forth-coming Assyrian Dictionary. The British Museum likewise (Aug. 1932) had no record of it. This would pretty thoroughly cover the field of possible known cases.

[13] *Ardu* signifies a servant, slave or restricted individual bound by some obligation of service.

[14] e.g. The city of the Female Servants of Ishtar, or The city of the Female Servants of the Erechites, found on SC 147:11.

[15] The name is written with the letters *âleph, dâleth* and *yôd. Âleph* is a consonant which has no equivalent English sound of its own but is pronounced according to the vowel that goes with it. In ancient times these vowels were not indicated, as everybody knew the pronunciation; later the Jews invented a system of indicating vowels, doubled letters etc. From Hebraic equivalents and the Babylonian form of this name, *Id-di-ia*, we render the Semitic form as 'Iddi (the 'I indicating *âleph* pronounced with an *i* sound) or 'Iddo, the usual Hebraic form of this name.

[16] It may be that these notations were made by scribes who were more familiar with the alphabet than with complicated cuneiform. The writing is of the kind found on parchment and may have been scratched in with a stylus by a parchment scribe. There were two orders of scribes, the *DUB-SAR* or tablet writer and the *KUŠ-SAR* or parchment writer. See Dougherty, R. P., *Writing upon Parchment and Papyrus among the Babylonians and Assyrians;* Jl. of the Amer. Oriental Socy., Vol. 48, pp. 109-135.

The mingling of cultures is often shown by a study of proper names.[17] Babylon was no exception. The old Babylonian names decreased and foreign names became common.[18] A Persian, Mitradâta, married a Babylonian wife, Ekur-bêlit, and the son was named Baga'mîri. From Persia would come such names as Aḫratush, Mānūshtānu and Mitradâtu. From Aramea would come Barîk-Bêl, Barîk-ilî; and from either Aram or Judea might come Abda' or Zabîdâ, i.e. Obadiah or Zebedee.

These has been some question about the segregation of Jewish names from Babylonian and the extent of Jewish influence in Babylon.[19] On this point, it might be noted that Hilprecht and Clay speak of the number of Jewish exiles in Nippur whose descendants lived in that city until a late period according to Hebrew inscribed vases discovered there,[20]—probably referring to incantation bowls discussed by Prof. Montgomery.[21] Furthermore "unusually large is the number of Jewish names known from the Old Testament, especially from the books of Ezra and Nehemiah, which we meet frequently in our own cuneiform inscriptions. Others are unknown in the Old Testament."[22]

In many cases, through the so-called endorsement or clerk's notation, the name in cuneiform can be compared with the same name in West Semitic alphabetic symbols. Certainly there are many that remind one of Hebrew names, e.g. *Addu - rammu,* Adoram; *Gadaliâma,* Gedaliah; *Ḫa-na-ni-'* or *Ha-na-ni-ia-a-ma,* Hananiah (Greek Ananias); *Ḫaggâ,* Haggai; *Ilî-idrî',* Eleazer; *Natan-ilî,* Nathaniel; *Nu-u-ḫa,* Noah; *Pani-ilî,* Peniel; *Shamshânu,* Samson (Hebrew Shimshon; and *Zabdîa,* Zebedee (Hebrew Zebadhya).

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[17] Cf. French names in England, Indian names in America, or Spanish names in the Southwest.

[18] Hilprecht, H. V. and Clay, A. T., in *Business Documents of the Murashu Sons of Nippur, dated in the reign of Artaxerxes I,* p. 27; Phila., 1898. In the Cassite period the influence was clearly recorded in the names. See Clay, A. T., *Personal Names of the Cassite Period,* New Haven, 1912.

[19] A careful study of the Babylonian and Persian period of Jewish history has been made by Prof. C. C. Torrey of Yale, whose *Ezra Studies* and brilliant analysis of the Deutero-Isaiah problem have been followed by a critical survey of Ezekiel and the Hebrew captivity, the traditional historicity of which he seriously questions. See his *Pseudo-Ezekiel and the Original Prophecy,* New Haven, 1930.

[20] Hilprecht and Clay, *op. cit.,* p. 27.

[21] Montgomery, J. A., *Aramaic Incantation Texts from Nippur,* Phila., 1913.

[22] Hilprecht and Clay, *op. cit.,* p. 27.

There are names on CSK 035 that would seem to fall within this category. The tablet concerns *Id-di-ia.* Noth gives three Hebraic forms of Iddo or Iddia,[23] one with initial *âleph,* א, one with initial *ayin,* ע, and one with both initial and final *âleph.* The name has West Semitic connections. Far up in Cappadocia has been found a certain *I-da-a* whose son was *Ú-zu-a,*[24] i.e. Iddo father of Uzzah, if given Biblical form. It would seem that *Id-di-ia* or *I-da-a* could be other than a Babylonian name.[25]

The father of *Id-di-ia* is given as *Aš-ši-ia.* This name is a possible derivative from the verb *našú* "to bear up" and as such could be Babylonian, but Tallqvist's name list does not give it.[26] He does find a very doubtful Assyrian parallel.[27] Noth[28] lists *Yishi* and *Ishi* which appear in I Samuel and Chronicles respectively as the Grecianized and later Anglicized "Jesse."

The first witness is *Za-ab-du-ilâni*^{meš}. Tallqvist[29] gives instances of this name, but with the singular *ilu,* "god," instead of plural *ilâni,* "gods," and suggests the Hebrew Zabdiel.[30] The father of this Zabdiel is *Ta-ḫu-ia* which, so far as is now known, is a new variant. Tallqvist found *Taḫu-ú-nu* which he interpreted as "Unser Kind." The new form, *Taḫu-ia,* might be interpreted "My child."[31]

The next witness is *Tuq-qin-eš-šu.* This also seems to be a new variant, as Tallqvist notes *Tuq-nu-eš-šu* but not the form found in this text. However, this is a minor point. The real interest concerns the father, *Šal-ti-ilâni*^{meš}, in whose name the last element presents the same problem as that in *Za-ab-du-ilâni*^{meš}

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23 Noth, T. M., *Die Israelitischen Personennamen in Rahmen der Gemeinsemitischen Namengebung.* Stuttgart, 1928.

24 Stephens, F. J., *Personal Names from Cuneiform Inscriptions of Cappadocia,* p. 22, New Haven, 1928.

25 The name also recalls Adaiah, an important Hebrew name found on jar handles in the temple rubbish at Jerusalem. Nine instances of this name occur in the Oid Testament. One noted in Nehemiah 11:10-14 and I Chronicles 9:10-13 was probably temple treasurer in the Neo-Babylonian period. See Duncan, J. G., *Digging up Biblical History;* London, 1931, Vol. II, pp. 140 and 145.

26 Tallqvist, K. L., *Neubabylonisches Namenbuch,* p. 16, Helsingfors, 1905. This volume contains long lists of personal names from cuneiform documents.

27 Tallqvist, K. L., *Assyrian Personal Names,* p. 32, Helsingfors, 1915. The Assyrian form is *Aš-ši-id,* may be intended for *Aššì-idi.*

28 Noth, *op. cit.,* p. 236.

29 Tallqvist, APN p. 245, see note 3.

30 See also Noth, *op. cit.,* p. 47 note.

31 Clay, A. T., *Personal Names of the Cassite Period,* p. 136, lists *Tu-ḫi, Tu-ḫi-e* and *Tu-ḫi-ia.*

above. Naturally the name suggests the West Semitic Shealtiel as occurring in the two Hebraic forms, Shaltiel שלתיאל and Shealtiel שאלתיאל. This name has appeared frequently and is noted by Tremayne, [32] Dougherty,[33] Noth,[34] and Tallquvist.[35]

Tallqvist finds the form *Šal-ti-ilu,* and Dougherty the form *Ša-al-ti-ilu.*

The usual interpretation of this name has been "I have asked of god."[36] But would a Jew have a name in which deity was pluralized, substituting *ilâni,* "gods," for *ilu,* "god"? In Hebrew the plural form *elohîm* is used for God without thought of plurality. Aside from a discussion of the theological controversies over this term *elohîm,* and suggestions of vestigial polytheism, the fact remains that this plural form was in common use when monotheism had become firmly established and there was no other implication than unitary deity and attendant majesty.[37] Yet such a form as Shealti-elohîm is not found in Hebrew.

Years ago Prof. Hilprecht observed that there were cases where the Neo-Babylonian plural sign, *meš,* obviously could not indicate plurality. A form like $^{d}Šamaš^{meš}$ referring to the sun god, Shamash, was a case in point. Ancient Babylonia was well aware that there was but one sun.[38] Hilprecht deduced that *meš* "must have been employed for expressing a sound which appeared to the Babylonian mind as one of their own plural endings," so when the scribe heard *ilî,* "my god," it sounded something like the long *e* sound of a plural ending and he wrote a plural sign, *meš,* to indicate it.[39]

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[32] Tremayne, A., *Records from Erech, Time of Cyrus and Cambyses,* p. 37, New Haven, 1925.

[33] Dougherty. R. P., *Archives from Erech, Time of Nebuchadrezzar and Nabonidus,* New Haven, 1923, p. 37, and *Records from Erech, Time of Nabonidus,* New Haven, 1920, p. 35.

[34] Tallqvist, K. L., *Neubabylonisches Namenbuch,* p. 187.

[35] Noth, *op. cit.,* p. 236.

[36] For the lay reader it might be stated that ancient names usually had definite meaning, with religious implications.

[37] A similar linguistic phenomenon may be found in the Abyssinian royal name Ikûnô 'Amlâk. The name complex, *iekûn ô 'amlâk,* literally, "let be to him God," makes use of the plural intensive, *'amlâk,* as an indication of high respect or majesty.

[38] It was suggested that in this case the scribe had really written the ideogram for the sun god, *UD,* plus a phonetic complement *meš* to show that it should be read as the name of some god ending in *meš,* hence *šammeš*$^{(meš)}$.

[39] Full discussion in Series A, volume IX of *Babylonian Expedition of the University of Pennsylvania,* Phila., 1898.

Fortunately, the same sort of alphabetical notations as those which appear on the tablet under discussion have furnished names of this kind in cuneiform and Aramaic. For instance, *Ra-ḫi-im-ilâni*^{meš} is written as West Semitic Raḫimel; *Ḫa-za-'-ilâni*^{meš} appears as Ḫaza'el, the familiar Biblical Hazael.[40] Here there is no question about a possible vocalic value but a clear case of the Babylonian plural form standing for the West Semitic singular deity element, *el*.[41] Just why Babylonian scribes wrote it so is not pertinent to the present discussion; the fact is enough. Not only is it possible to see Shealtiel in the Babylonian *Šalti-ilu,* but also in *Šalti-ilâni*^{meš}.

Turning for a moment to tablet SC 96, we note that it also involves a loan and the payment on principal and interest. Here, however, the names are clearly Babylonian with the exception of Enurta-ibni, which is compounded with a West Semitic deity. This does not make him a Western Semite, yet it halts attention when associated with a reference to the city of bondmen.

Summarizing, we find two documents executed in a community known as the city of bondmen. Both are executed in the early reign of Nabonidus, within three years of each other. Both involve loans and payment on principal and interest. Both contain one or more names of West Semitic import that call for consideration from the standpoint of Hebrew and Aramaic parallels. The evidence is scanty and at best circumstantial, yet it seems more than coincidence that such a combination of suggestive data should occur.

There were some Jews in Babylonia. Babylonian service permitted considerable latitude to individual activities. Commercial ventures, property, and wealth were possible to expatriates, Jews or any other group. The typical oriental social psychology tended to definite grouping by guilds, types of service, race or social status. A settlement of bondmen might consist of such a social unit. No complete definition of such a colony could be made without contour data and sufficient tablets to supply cumulative linguistic evidence as to the exact character of the inhabitants. Tablets SC 96 and CSK 035 stand alone at present, stimulating tentative suggestions, and awaiting coördinate evidence.

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[40] *Old Testament and Semitic Studies in Memory of William Rainey Harper*, ed. by R. F. Harper, Francis Brown, G. F. Moore, Vol. I, Univ. of Chicago Press, 1908, p. 294.

[41] Hilprecht even says that "we find the singular *el* (Hebrew) in use where Babylonian scribes as a rule offer *ilu*^{meš}." See also Hehn, J., *Die Biblische und die Babylonische Gottesidee*, Leipzig, 1913, p. 169 ff.

TEXT CSK 035—BORROWING OF TAX MONEY

[1]2 šiqlê ribût(-ut) kaspi makkûr šarri [2]ša GIŠ-BAR ša [md]En-lil-šar-uṣur [3]ša qât [m]([d]Bêl?)- ê-ṭi-ru-[d]Šamaš [4][amêl]bêl pi-qit-tum ša [md]En-lil-šar-uṣur [5]ina muḫ-ḫi [m]Id-di-ia apil-šu ša [6] [m]Aš-ši-ia ina [ara]Šabâti kaspa-ám [7]2 šiqlê ribût(-ut) ina qaqqadi-šu [8]i-nam-din [9] [amêl]mu-kin-nu [m]Za-ab-du-ilâni[meš] [10]apil-šu ša [m]Ta-ḫu-ia [m]Tuq - qin - eš - šu [11]apil-šu ša [m]Šal - ti - ilâni[meš] [12]u [amêl]dupšar [md]Nabû-bâni-aḫi apil-šu [13] [md]Ea-mukîn-apli âlu ša [amêl]ardâni[meš] [14] [ara]Ṭebêtu ûmu 26[kam] [15]šattu 8[kam] [md]Nabû-nâ'id [16]šar Bâbili[ki]
L. E. *le 'idi*

Translation

[1]2¼ shekels of silver, property of the king, [2]which is/out of the tax of Enlil-shar-uṣur [3]entrusted to Bêl-êṭiru-Shamash [4]the steward of Enlil-shar-uṣur [5]is to be paid by Iddia son of [6]Ashshia. In the month Shebaṭ the silver, namely [7]2¼ shekels on his principal [8]he shall pay. [9]Witness: Zabdu-ilâni [10]son of Taḫuia; Tuqqinešši [11]son of Shalti-ilâni [12]and scribe: Nabû-bâni-aḫi son of [13]Ea-mukin-apli. (executed) City of the Bondmen [14]Ṭebet 26th [15]8th year of Nabonidus [16]king of Babylon.
L. E. Belonging to Iddi.

TEXT SC 77—STIPULATION TO PAY DATES

[1]4 gur 2 pi 18 qa suluppi [2] [md]A-num-aḫe[meš]-uṣur apil-šu ša [3] [m]Aḫê[meš]-šu-nu ina muḫ-ḫi [md]Bêl-êṭir-[d]Šamaš [4]apil-šu ša [m]Apla-a ina [ara]Du'ûzi 4 gur 2 pi 18 qa [5]suluppi ina qaqqadi u ḫubulli(?) [6]ina âlu ša ardâni[meš] i-nam-din [7]suluppi maš-šaḫ?-ti [8]u-il-tim ša ma-ḫi-iṣ bu-tu-tu [9].... ša [md]Enurta-ib-ni [10]mu-kin-nu [m]Ri-mut-[d]Bêl [11]apil-šu ša [m]Ṣil-la-a [m]Ardi-[d]Bêl [12]apil-šu ša [md]Nabû-šum-lîšir [13]u [amêl]dupšar [m]Ni - din - tum - [d]Bêl NIK (?).SU (?) [14]apil-šu ša [md]Bêl - aḫ - ušabši(-ši) [15]âlu ša ardâni[meš] [ara]Du'ûzu [16]ûmu 27[kam] šattu 11[kam] [17] [d]Nabû-nâ'id šar Bâbili[ki]

Translation

[1]4 kor 2 pi 18 qa of dates [2]Anum-aḫe-uṣur son of [3]Aḫê-shunu to be paid by Bêl-êṭir-Shamash [4]son of Aplâ. In the month Tammuz, 4 kor 2 pi 18 qa [5]of dates on principal and interest [6]in the city of bondmen he shall pay. [7]Dates measured. (?) [8]Document of agreement. (?) (lit. striking responsibility.) [9] .... of Enurta - ibni [10]Witness: Rîmût - Bêl [11]son of Ṣillâ; Ardi - Bêl

[12]son of Nabû - shum - lîshir [13]and scribe: Nidintum - Bêl ? ? [14]son of Bêl-aḫ-ushabshi. [15]City of Bondmen, Tammuz [16]the 27th, 11th year of [17]Nabonidus king of Babylon.

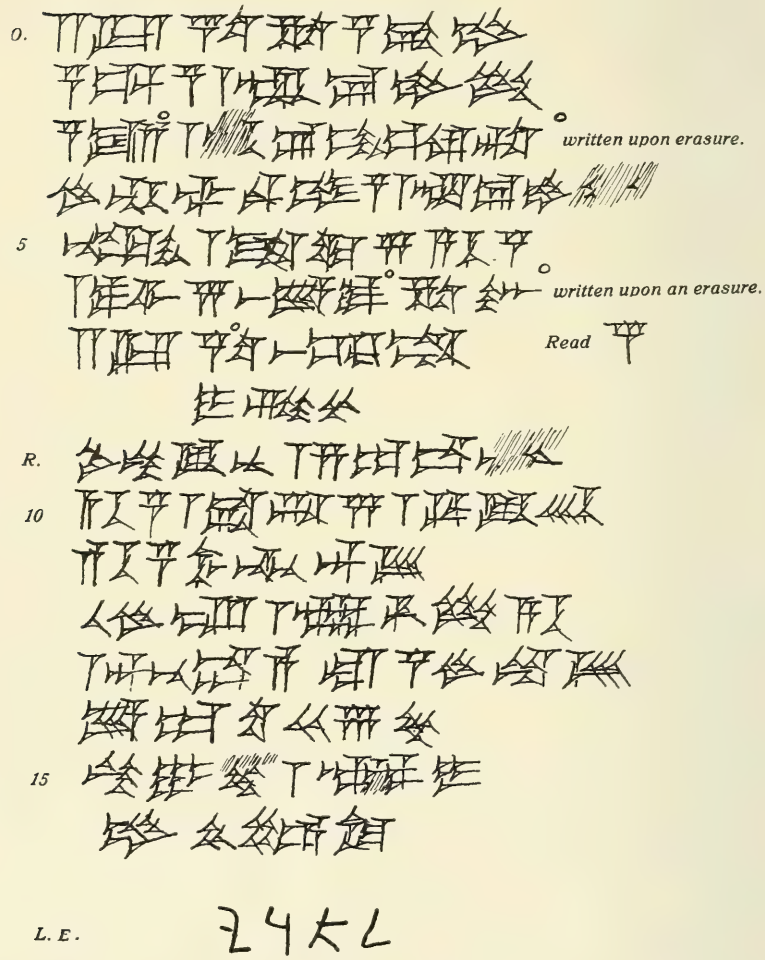

PLATE XI.

Autograph copy of tablet CSK 035 showing scribe's notation in alphabetical characters on the edge of the document.

PLATE XII.

Obverse of tablet CSK 035 referring to a city of bondmen.

PLATE XIII.

Clerk's notation incised on edge of tablet. Reading from right to left, the alphabetical characters are *l, 'i, d, i,—le 'Idi,* "belonging to Iddo," or Iddia as he appears in the cuneiform text. Tablet was photographed upside down to obtain proper lighting.

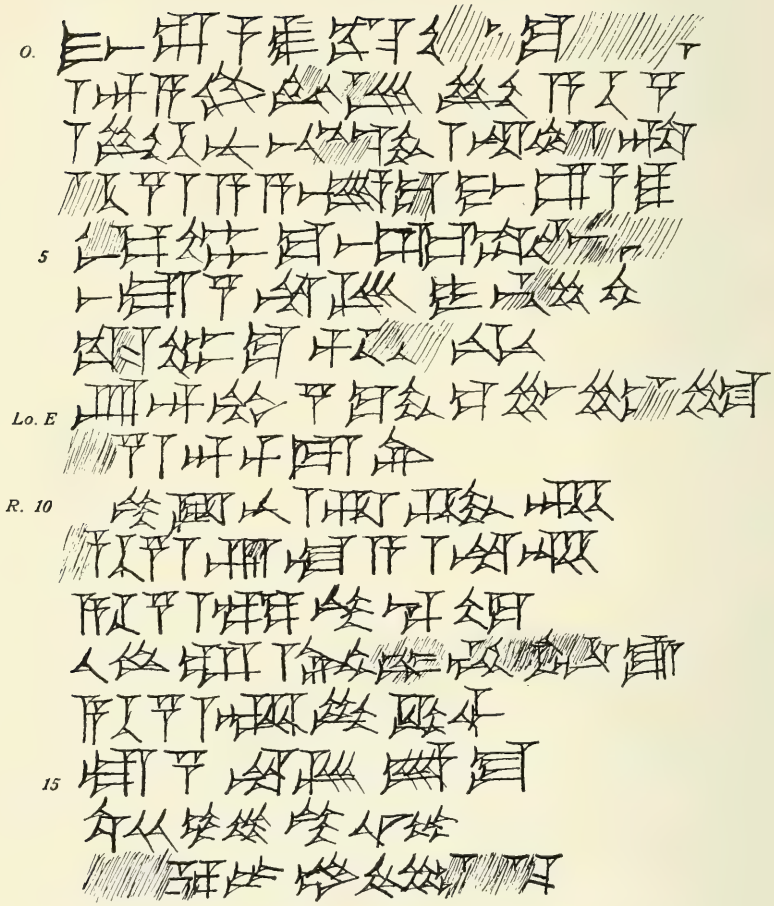

PLATE XIV.

Autograph copy of tablet SC 77, also referring to the city of bondmen.

Text SC 134 has presented not only a problem in decipherment but further historical problems of far-reaching import growing out of variant readings.

The tablet is 1⅞″ x 1⅜″ x ¾″, 17 lines of text, deeply incised but considerably flaked in lines 8-11, preventing smooth translation but in no way interfering with the point to be discussed. The tablet was incrusted with what appeared to be saline deposits. Fortunately, before trying dilute hydrochloric acid the tablet was immersed in distilled water, dried and carefully brushed. The incrustation was found to be a smear of clay such as might have resulted from dampness at the time of excavation.

Careful inspection of the tablet reveals that lines 4 and 16 contain a proper name followed by *šar-mâtâti* "king of countries" the usual royal title of the Persian era. The proper name varies, however, as in line 16 it ends with *šu,* which is omitted in line 4. The first sign (line 4) is clearly *ku,* with the initial upright wedge obliterated. The four horizontal wedges of the *ra* sign are badly mutilated, but the general form is unmistakable. Under a microscope the fine horizontals of the *aš* sign appear. The second sign is clearly the *kur* or *šat* sign. The reading, then, might be either *Ku-kur-ra-aš* or *Ku-šat-ra-aš.* Line 16 is quite clear and verifies the reading, adding *šu.*

On the left edge of the document is a seal impression, with three thumb-nail marks above and below. The figure on the seal is evidently a bowman, with head dress and general aspect scarcely Babylonian, but suggestive of some of the Persian, Assyrian, Hittite and northern figures.[42] The tablet was not executed in Babylon, but at Nippur, at the hand of the scribe Rîmût son of Gimillu.

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[42] The original impression of this seal was not good, and a slight crack and flaking have further destroyed the lines. The bowman *motif* is similar to certain Hittite seals. Two prominences correspond with the shock of curled hair and beard often found on Assyrian seal figures. The face is almost obliterated, though in certain light suggestive traces of the northern "bird nose" are observable. The cap seems Persian, though at certain angles it seems to resemble some of the Hittite forms. The chief point is that the figure is not characteristically Babylonian. Similar figures appear on the frieze of Iasili-Kaia, the figure from Jerabis and on seals noted by Ward and Legrain. See *International Standard Biblical Encyclopedia.* Chicago, Howard-Severance Co., 1915, pp. 1399 and 1401, Ward, W. H., *The Seal Cylinders of Western Asia.* Washington, 1910 and Legrain, L., *The Culture of the Babylonians from Their Seals in the Collections of the Museum.* Phila., 1925. Pl. XLIII-XLV.

At first thought, the easier reading of the name is *Ku-kur-ra-aš(-šu)* and the easiest interpretation would be Cyrus. Such a duplication as *ku-kur* for *kur* is not uncommon, e.g. *di-dim* for *dim*, *pa-par* for *par*, *ki-kir* for *kir*, but is characteristic of Hittite and the north.[43] There are instances of this duplication where late Babylonian scribes were making an interlinear translation of ancient Sumerian hymns,[44] but it must be remembered that they were probably working from old material. At least, it was not a case of the routine execution of a Neo-Babylonian tablet. According to information at hand, no such writing has appeared in Neo-Babylonian contracts.

The form on this tablet, then would not only be unusual in a general sense, but absolutely unique as a rendering of Cyrus. The usual forms of the name Cyrus are:[45]

Ku-ráš[46]	*Ku-ráš-šu*	*Kur-ra-aš*
Ku-ra-aš	*Kur-ráš*	*Ku-ur-ra-aš*
Kur-aš	*Kur-ràš*	*Ku-ur-ra-aš-šu*
Ku-ra-šu	*Kur-ra-áš*	*Ku-ur-šu*

If the scribe really intended to write the name Cyrus, we can only say that text SC 134 gives an important variant of the form of the name. Beyond that, there would be nothing of import in a simple business document drawn in the second year of this well known Persian king. Many, preferring to accept the unusual combination *ku-kur* as a rare Neo-Babylonian writing of *kur*, may ascribe the tablet to Cyrus' reign, and rest the case there.

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[43] Deimel, *Sumerisches Lexikon* 334,109 quotes a reading of *Keilinschriften aus Boghazköi* I, No. 42 obverse 1:18 as: *A.GIŠ.GAR.RA* = *iš* ^{ga}*-gar*. The publication in which this reading is found is Weidner, *Studien zur hethitischen Sprachwissenschaft*, 60. This is an example of the sign *GAR* glossed with *GA* to show the pronunciation, just as *KUR* might be glossed with *KU*.

[44] Reisner, Geo., *Sumerisch Babylonische Hymnen nach Thontafeln Grieschischer Zeit*, Berlin, 1896. See No. 14, obv. line 2 and No. 28, rev. line 11. Line 2 reads *uš-ta-taḫ-ri-ir* for *uš-taḫ-ri-ir*, but line 11 is doubtful. It might be *uš-ta-tal-pit* for *uš-tal-pit*, but the *tal* sign can also be read as *ṣab* and the *pit* sign as *bit*, hence *uš-ta-ṣab-bit*. (So Meissner, 7216). In this connection thanks is due Dr. A. Walther of the Oriental Institute, University of Chicago. In personal correspondence, June 8, 1932, he called attention to a number of these duplications and suggested that "probably the marginal nations as the Hittites and later Babylonians used the signs of three sounds and considered them as wanting explanation."

[45] Tallqvist, K. L., *Neubabylonisches Namenbuch*, p. 92. Tremayne, A., *Records from Erech, Time of Cyrus and Cambyses*, New Haven, 1925, p. 26. See also Weissbach, *op. cit.*

[46] For the lay reader let it be said that the diacritical accents are indicative of different signs. They have no vocal implication. The *š* is *sh*.

The fact that a duplication like *ku-kur* for *kur* is not characteristically Neo-Babylonian raises the question as to what might be the implications if the *kur* sign were given its other value of *šat*. This admittedly harder reading prompts two considerations. The first would be equating the resultant *Ku-šat-ra-aš(-šu)* with some form of the name Xerxes. There is a Nippur text with his name, rendered *Ḫi-si-'-ar(-su)* quite different from *Ku-šat-ra-aš(-šu)*.

At least 26 variants of the name of Xerxes are known, none of which approximates the name under discussion. Weissbach[47] lists the following forms:

Ḫi-ši-'-ar-ša-'	*Ḫi-ši-ar-ši*
Ḫi-ši-'-ar-ši	*Ḫi-ši-ar-šu*

In the Zeitschrift der Deutschen Morgenlandischen Gesellschaft, Vol. 62, p. 158, the following forms are given:

Aḫ-ḫa-ri-šu	*Aḫ-ši-ri-ar-ši*	*Ak-ši-ia-ar-ši*
Aḫ-ši-a-mar-šu	*Aḫ-šu-mar-ši-'*	*Ak-ši-ma-ak-šu*
Aḫ-ši-ia-ar	*Ak-ka-ši-ar-ši*	*Ak-ši-ma-ar-šu*
Aḫ-ši-ia-ar-šu	*Ak-ki-iš-ar-šu*	*Ak-šu-ar-šu*
Aḫ-ši-i-mar-šu	*Ak-ši-ak-ar-šu*	*Ḫi-ši-ar-ši-'*
Aḫ-ši-is-mar-ri-ši	*Ak-ši-ar-šu*	*Ḫi-ši-ia-ar-šu*
Aḫ-ši-mar-šu	*Ak-ši-ia-ar-'-šu*	*Ḫa-ši-i-ar-šu*
	Ḫi-ši-'-ar(-šu)	

It would seem then that both in and outside of Nippur the name of Xerxes was written either with an initial voiced guttural, *ḫ*, or an initial *a* vowel plus the voiced guttural or a voiceless guttural mute, *k*. In no form does the voiceless guttural mute form the initial sound, nor does the *u* vowel appear in the first syllable. Furthermore, in the twenty-six noted forms, *ar* frequently occurs, but never *ra*, the instance of *ri* being the nearest approach to it. *Aš* is lacking in all forms.

If the *kur* sign is read *šat*, then we have a dental, *t*, preceded by a sibilant and the *a* vowel, forming a heavily emphasized syllable ending in a dental stop, *t*, before a following liquid consonant, *r*. Such a combination could scarcely represent a capricious variation of Xerxes, and there is no evidence of dialectic fixation in Nippur texts.

The reading of the name as *Ku-šat-ra-aš(-šu)* suggests another line of investigation. The famous Darius inscription on the

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[47] Weissbach, F. H., *Die Keilinschriften der Achämeniden*, Leipzig, 1911.

Rock of Behistun[48] lists nine rebel chieftains who opposed the accession of Darius. Written in three versions, Persian, Susian and Babylonian, close comparison of personal names is possible. The third figure in the row of captives is a certain Median pretender. His Persian name was Fravartiš[49] or Fravartaiš,[50] written in the Susian version as Pirrumartiš,[51] (note how the softer *f* of the Persian becomes *p* in the Susian form and *v* passes over into *m*, *F-r-v-r-t-š* to *P-r-m-r-t-š*) and in the Babylonian *Pa-ar-ru-mar-ti-iš*[52] or *Pa-ar-mar-ti-iš*,[53] whence came the corrupt Grecianized form of Phraortes. (Note *P-r(-m)-r-t-s* again.)

This pretender, in order to promote his claims, assumed the name of Khshathrita of the family of Cyaxares.[54] The revolt spread over considerable territory and these fighting Medes who had not forgotten the days of independence before Cyrus, constituted Darius' most serious threat.

The assumed name is extensively used in the Behistun record and can be followed through the three versions. The Persian form appears as *Khshathrita*,[55] the elements being *K-sh-t-r-t*. In the Susian version the second element, *šat*, is especially prominent being the initial syllable of the Susian form. The Susian forms are *Šattarrita*[56] and *Šattarritta*.[57]

Turning to the Babylonian version we find *Ḫa-ša-at-ri-tum*,[58] *Ḫa-ša-at-ri-it-ti*,[59] and *Ḫa-ša-at-ri-e-ti*.[60] In each of these cases the dental stop, *t*, which never appears in forms of Cyrus or Xerxes, is conspicuous. The exchange of a voiceless guttural mute, *k*, and the aspirated guttural, *ḫ*, is not impossible, for the Kampada district in Media is spoken of as the city or district of *Ḫa-am-ba-nu* in the Babylonian version. In the linguistic

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48 See Rogers, R. W., *A History of Ancient Persia*, Scribners, N. Y., 1929, p. 95 ff. King and Thompson, *The Sculptures and Inscriptions of Darius the Great on the Rock of Behistun in Persia*, British Museum, London, 1907.

49 Behistun Inscription, Column II, line 14; line 17 *Fravartim*.

50 Behistun Inscription, Column II, lines 69 and 93.

51 Behistun Inscription, Column II, lines 9, 50, 52, 53, 68; Column III, line 53; and on skirt of garment.

52 Behistun Inscription, lines 43, 44, 58, 59, 60 of Babylonian version.

53 Behistun Inscription, lines 62 and 92 of Babylonian version.

54 See Rogers, R. W., *op. cit.*, p. 92.

55 Behistun Inscription, Col. II, line 15; IV, line 19; etc.

56 Behistun Inscription, Col. II, line 10.

57 Behistun Inscription, Col. III, line 54; and above the carved figure of Khshathrita.

58 Behistun Inscription, line 92, Babylonian version.

59 Behistun Inscription, line 43, Babylonian version.

60 Behistun Inscription, line 3, Babylonian version under figure of the captive.

chaos of the Persian period, such elements as *k-sh-t* and *h-sh-t* were not mutually exclusive.

Khshathrita was not a Babylonian and the inscription at Behistun was put up by Persians, while the tablet under discussion, SC 134, was written probably by a Babylonian scribe at Nippur. This might account for the use of *Ku* as the initial syllable, if he really were writing the pretender's name. If so, the scribe clearly caught the second element, *šat,* with its characteristic sibilant-dental vocalization. Then at the end of the name, the voiceless dental, *t,* passed over into the sibilant, *š.*

Thus if the tablet is read *Ku-kur-ra-aš(-šu)* the writing is very unusual and open to some objections. If it is read *Ku-šat-ra-aš(-šu)* the name clearly reduces to elements that call to mind the Medo-Persian pretender.

Such an assumption combined with the dating in the second year presents a problem and certain implications. The tablet is clearly dated on the 18th day of the 12th month of the 2d year of *Ku-šat-ra-aš(-šu)* but the modern calendar date would depend upon what year in Darius' reign the revolt started. The Behistun inscription helps little, except to suggest that the revolt was not a passing one. Two years might have been consumed in quelling it.

Maspero,[61] states that "to defeat Khshatrita was the work of a few weeks only." The Cambridge Ancient History[62] (Vol. IV, p. 176) states that "it can be concluded that all the events fall in the five months of his (Darius') accession year and the first year of his reign." Also, Darius was able "to secure peace and quiet throughout his dominions within a year or two of Cambyses' death." (CAH Vol. IV, p. 181). None of these passages makes sufficient allowance for a situation that would yield a Nippur tablet dated in the second year of a Median pretender. Time and a penetration of influence out of all proportion to what has been previously considered the succession of events are indicated.

A hint of the longer period involved in the rebellions against Darius is given in the British Museum publication of *The Inscription of Darius at Behistun*[63] (xxxviii) supported by reference to Prašek *Beiträge zur alten Geschichte* (Bd. I, p. 41 ff) and *Geschichte der Meder und Perser* (Bd. I, p. 260 ff). Says IDB at this point: "The rebellions . . . the suppression of which is recorded in the inscriptions, have been supposed to have taken place

[61] Maspero, G., *History of Egypt*, Vol. IX, London, 1904, p. 174.

[62] Hereafter indicated by CAH.

[63] Hereafter indicated in the text by IDB.

within the first nine years of the reign of Darius." Cambyses' death occurred in 522 B. C. or 521 B. C.[64] Persia and Media had already turned away from him, though not from the house of Cyrus. (CAH 174). While Cambyses was yet in Egypt Gaumâta, a Persian born at Pisyauvada, succeeded in winning Perso-Median support.[65] "That Gaumâta succeeded in ascending the throne of Persia is proved by the fact that Babylonian contract tablets, dated in his reign, have been discovered." (IDB xl).

Here is definite evidence of a case where a Median usurper's name appears in Babylonian contracts just as Khshathrita's name appears in text SC 134, according to the tentative interpretation under discussion. Even the combination of his name with *šar mâtâti* "king of countries" alone is present.[66] But these tablets are chiefly of the accession year (*reš šarrûti*) or the first year (*šattu 1*^{kam}) yet it is clear that in certain quarters he was accepted as sovereign and his name used in legal date formulae. In other words, a usurper and rebel against Darius could obtain recognition in the accession year; certainly one could possibly do so by his second year, as would be the case if the following reading stands: *šattu 2*^{kam} ^{m}*Ku-šat-ra-aš(-šu) šar mâtâti*^{meš}; "2d year of Kushatrash, king of countries."

The revolt of Ashina in Susiana was brief, but Nidintum-Bêl of Babylon, claiming to be Nebuchadrezzar III, son of Nabonidus, gave sharp opposition. The last known tablet of the pseudo-Smerdis is dated the 1st of Tishri; the first tablets of the Nidintum-Bêl régime are dated the 16th and 20th of the same month.[67] Darius immediately moved against Nidintum-Bêl and defeated him at the Tigris. The Babylonian fell back and gave battle at the Euphrates. Thence he fled with a few horsemen, was captured in Babylon and executed.

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[64] CAH, p. 173, fixes Cambyses' death in the spring of 522 B. C. so also Rogers, *History of Ancient Persia*, p. 84 ff. The rebellion of Gaumâta, the Pseudo-Smerdis or Barzia, ended with his death in autumn, 522 B. C. Maspero places Gaumâta's rebellion in March, 521 B. C.

[65] The Pseudo-Smerdis, sometimes called Bardia or Bardiya. (so Rogers, *History of Ancient Persia*, p. 85). The Babylonian scribes wrote it *Bar-zi-ia*. The real Bardiya, (Greek Smerdis) had been secretly slain by his brother, Cambyses. Gaumâta was a living image of the dead man, so launched one of the great plots of history, posing as Bardiya, hence later called the Pseudo-Smerdis. He was finally exposed by Phaedime, wife of Cambyses and member of the harem. (Herodotus, III, 68 ff.) cf. Maspero, *History of Egypt*, Vol. IX, p. 155.

[66] Strassmeier, J. N., *Inschriften von Nabopolassar und Smerdis*, *Zeitschrift für Assyriologie*, IV, pp. 123-128. See also Weissbach, F. H., *Die Keilinschriften der Achämeniden*, Leipzig, 1911, p. 154.

[67] Note here also that the names of rebel pretenders soon entered the date formulae of contemporary business documents.

Darius' own account seems to allow little lapse of time in these events, yet Herodotus speaks of a siege of twenty-one months. Furthermore, tablets dated in the first and second years of Nebuchadrezzar III would imply that the struggle lasted on into the second year, probably until 520 B. C.[68] During this time Darius would scarcely be recognized as king in Babylon or Nippur. If Darius captured Babylon within the few months or weeks between late 522 B. C. and early 521 B. C., then documents would normally pass from a Nidintum-Bêl date formula to a Darius formula. If on the other hand the Herodotus tradition rests upon fact and the interim between Nidintum-Bêl and Darius was considerable; and if in the meantime other political influences were penetrating the empire, a Nippur document might reflect such a situation in a date formula that ignored the struggling Darius.

While engaged at Babylon, Darius sent Dadarshish to quell the Armenian revolt. First contact was made at Izzila, in Assyria, May, 521 B. C. Three battles failed to solve the problem, so Darius sent another troop under Vaumisa, a Persian, who met the Armenians at Autiyara in January. The question arises as to whether this was the January preceding or following the May date, i.e. five months or seventeen? The Cambridge Ancient History suggests a reversal of the order of the expeditions, Vaumisa being first, and the time of the whole conflict reduced to a few months, January to May, 521 B. C.[69]

Aside from conflicting ideas about the time factor,—and as has been stated the Behistun records offer little resistance,—the succession of events is pretty well known. Shortly after the dispatch of the first army against Armenia, news of the Median revolt reached Darius as he besieged Babylon. Khshathrita's initial success and influence won the support of Parthians and Hyrcanians. After an account of the Elamite uprising, (column XXIII) the Behistun inscription reviews the rise of *Ḫa-ša-at-ri-it-ti*. Then follows the account of the expedition from Babylon.[70] Darius marched into Media and met Khshathrita at Kundurush. The rebel was defeated and fled with a few horsemen to Raga in eastern Media. Darius moved on to Ecbatana, and Khshathrita, captured at Raga, was brought to him, mutilated, and crucified.

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[68] Maspero, G., *History of Egypt*, p. 165, note. Hereafter referred to as HE.

[69] CAH p. 178.

[70] No date is given. If the siege was short, Darius may have started out sometime between May and September, 521 B. C.

After Darius left Babylon "the Babylonians seized the opportunity of rebelling a second time."[71] There seems no question of this challenge to Darius' supremacy. Darius himself notes it. This is probably the implication of *ina ša-ni-ti harrâni,* "in the 2d expedition." This checks with the Susian phrase, *II-ummê-ma.*[72] Darius' own account runs as follows:

> A certain man named Arakha, an Armenian, the son of Ḫalddita, rebelled in a city in Babylonia named Dubala and thus did he lie to the people saying "I am Nebuchadrezzar, the son of Nabonidus." And then the Babylonian people revolted from me and went over to that Arakha and he seized Babylon and became king in Babylon. And then I sent an army unto Babylon . . . Vindafrana took Babylon and he brought over the people unto me. On the 22d day of the month Markazanash that Arakha . . . was seized and fettered . . . Then I commanded saying "Let that Arakha and the men who were his chief followers be hanged on crosses in Babylon."

Arakha was, then, an Armenian. Authorities agree that his reign was short. In the Behistun inscription the account of his defeat closes the historical section. Soon after the return of the victorious army Darius ordered the sculptures. A later Susian revolt was subsequently carved upon the rock. In the fifth column the year was inscribed, but unfortunately the signs are mutilated.[73]

A comparison of chronology given by Maspero and the Cambridge Ancient History reveals considerable variation between the older and later work.

Cambridge Ancient History		Maspero HE
Cambyses' death, spring	522 B. C.	
Gaumâta's death, fall	522	.....Dec., 521 B. C.
Darius king	522	
Nidintum-Bêl, Oct.-Dec.	522	
Nidintum-Bêl, death, probably Feb.	521	..Mar.-Apr., 520
Armenian defeat, Jan. and May	521	 520
Darius leaves Babylon, probably summer	521	
Khshathrita's death	521	 519
Arakha's death, Nov.	521	.....Dec., 519

[71] IDB xliii.

[72] IDB 194, n. 2.

[73] CAH, p. 182, suggests probably 4th or 5th year.

The older chronology represented by Maspero involves a period of two years during which time the position of Darius was uncertain. In the Chronological Notes, CAH IV, p. 662, it is pointed out that Darius states that all the events noted at Behistun occurred *hamahyaya tharda,* and this is assumed to mean "in the same year." The month dates given for the nineteen battles can scarcely be brought within the compass of a year. Darius exaggerated, or "in the same year" is not an exact translation of his statement. That "it is possible so to interpret the inscription that the period covered does not exceed seventeen months"[74] is true, but it is equally true that a Nippur tablet acknowledging a two-year supremacy of a distant rebel would indicate data as yet unrecovered.

The easy way to interpret would be to place greater confidence in Herodotus' statement as to the length of the Babylonian siege, and to follow more closely Maspero's chronology. On the basis of a tentative reading on one tablet it would be dangerous to attempt conclusions as to events or chronology. That authorities differ as to the length of Darius' struggle for the throne is apparent. That the time involved varies from twelve to twenty-four months is clear.

If a Nippur scribe really did intend to write a Khshathrita date formula on SC 134, then he has introduced a definite time factor into the Behistun records. The tablet at least induces a re-examination of the whole period and indicates a direction of research for additional texts.[75]

TEXT SC 134—RECORD OF PROFITS

1 *2 šiqlê ribût(-ut) mâṭî(-ti) kaspi* 2 *^{m}Ri-mut apil-šu ša* *^{md}Bêl-uballiṭ(-iṭ)* 3 *ina il-ki ša (šatti) 2^{kam}* 4 *^{m}Ku-šat-ra-aš šar mâtâti* 5 *ina qât ^{m}Bêl-êṭir-^{d}Šamaš apil-šu ša* 6 *^{m}Apla-a ma-ḫir (?) e-lat ribût(-ut) kaspi* 7 *pu-ut kaspi ina ma-? ša* *^{amêl}(ku)-tal (-la)-tu* 8 *ina* *^{arah}Addari ....* 9 *pa-si .... (a)-na* *^{amêl}zab-bil* 10 *^{m}Bêl-êṭir-^{d}Šamaš i-nam-din* 11 *.... a-na muḫ-ḫi* *^{amêl}ku-tal-la-a-tu* 12 *^{amêl}mu-kin-nu ^{m}Na-din apil-šu ša ^{m}Qud-di-ia* 13 *^{md}Šamaš-šum-ibni apil-šu ša ^{md}Enurta-bâni-ahi u* *^{amêl}dupšar* 14 *^{m}Ri-mut apil-šu ša ^{m}Gi-mil-lu* 15 *Nippuru^{ki}* *^{arah}Addaru ûmu 18^{kam}* 16 *šattu 2^{kam}* *^{m}Ku-šat-ra-aš-šu* 17 *šar mâtâti^{meš}*

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[74] CAH p. 663.

[75] Those interested from a Biblical standpoint might connect this question of Darius' accession with the Haggai-Zechariah episode and the crowning of Zerubbabel. Why did the Jews imagine they *could* do such a thing in the face of Persian domination? Why did the project get as far along as it did? Why does a curtain of silence suddenly fall, cutting off further knowledge of Zerubbabel or the abortive *coup d'Etat?* Was Darius' accession a matter of months or years?

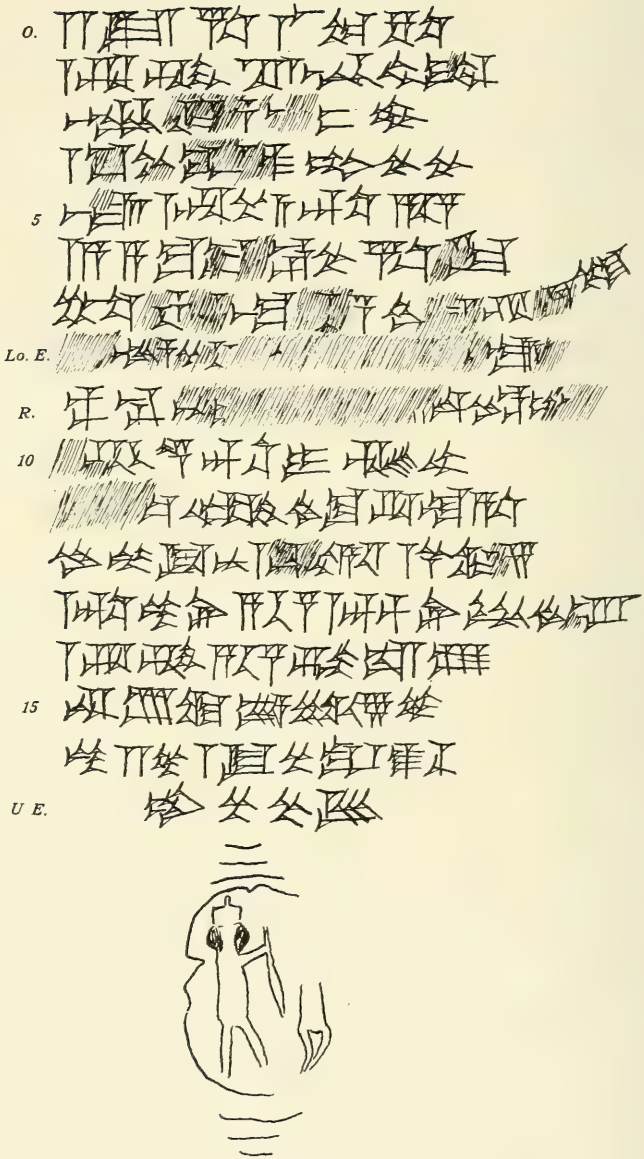

PLATE XV.

Autograph copy of tablet SC 134. The third sign in line 4 and the sixth in line 16 has both the values *kur* and *šat*, giving rise to suggestive speculation about an episode in Persian history.

Translation

[1]1¾ shekels of silver [2]Rîmût son of Bêl-uballiṭ [3]out of the business of the 2d year of [4]Kushatrash, king of countries [5]from Bêl-êṭir-Shamash son of [6]Aplâ received (?) Furthermore/in addition (in regard to) the ¼ shekel, the [7]responsibility of the silver rests upon (?) the *kutallatu* official [8]in the month Adâr .... [9] ? ? .... unto the porter [10]Bêl-êṭir-Shamash shall pay [11].... for the *kutallatu* official [12]Witness: Nâdin son of Qudîa; [13]Shamash-shum-ibni son of Enurta-bâni-aḫi; and scribe: [14]Rîmût son of Gimillu [15]Nippur; Adar the 18th [16]2d year of Kushatrash [17]king of countries.

PLATE XVI.

Obverse of tablet SC 134. The debatable sign consisting of three oblique wedges is quite clear in line 4.

How Some Babylonian Records Were Made

In deciphering cuneiform documents it is often helpful to compare the proper names with those listed by other investigators. When such a comparison was made between SC 74 and text No. 168 in a volume published by Keiser in 1918,[76] a striking similarity was discovered. An interlinear transliteration (q. v.) and translation (q. v.) shows the duplication.

[76] Keiser, C. E., *Letters and Contracts from Erech in the Neo-Babylonian Period*. New Haven, 1918.

PLATE XVII.

Seal impression on edge of table SC 134, showing thumb-nail marks. Sometimes a Babylonian countersigned or validated his seal by such marks, and in many cases the thumb-nail marks alone were used.

If no Babylonian documents in duplicate had ever been found, it would still be logical to assume that such a practice was in vogue. A number of texts in the SC collection have the characteristic term *ḫi-bi,* "broken," indicating that the scribe was copying from a damaged original. Other investigators have found exact duplicates.[77] SC 74 is all the more interesting because it is not an exact duplicate of Keiser's No. 168, yet obviously bears some relation to it.

The general arrangement of the texts is the same, but with copious details added in Keiser's document. At many points, broken sections of one tablet may be restored by reference to the other.[78] SC 74 omits the plural sign and the initial *la* of the first place name. Lines 6-20 of the Keiser text concern dates and tax items of the fields of the city of Lasûtu; SC 74, lines 1-10 cover the same transaction. Lines 21-29 of Keiser's text parallel lines 11-16 in SC 74, the city of Dûru-ša-Itiri.

The extra lines in Keiser's text seem to fill out details of the original transaction. There is mention of a tax in line 3, and a date in lines 4 and 5. At certain points the spelling has been modified. Added data on parentage are given. Keiser's text

[77] Dougherty, R. P., *Records from Erech, Time of Nabonidus*, New Haven, 1920. Texts 169 and 231; 71 and 72. Also, Ungnad, A., in *Zeitschrift für Assyriologie*, XXIII, p. 73 ff., and in *Vorderasiatische Schriftdenkmaler*, Leipzig, 1907-1908; (*Neubabylonische Kontrakte*) Vol. III, Nos. 64, 65; 94, 95; 131, 132; 138, 139; Vol. IV, Nos. 87, 88; 92, 93; 115, 116; Vol. V, Nos. 43, 44; 57, 58; 70, 71; 74, 75; 87, 88; Vol. VI, Nos. 90, 91; 101, 102.

[78] Note beginning of first line.

omits the *gur* (a measure) sign in the majority of cases. Principally the deviation concerns an apportionment of tax, *ma-ak-ka-si,* and an additional measure of date bunches, (?) *sis-sin-nu.* Keiser's scribe also resorts to abbreviation, *ma* for *ma-ak-ka-si* and *KI-2* for classic Sumerian *KI-MIN,* meaning "ditto," referring back to the *sissinnu* of line 7k.

The differences between the two tablets are such as might be expected if a scribe made a temporary notation of a transaction,[79] including persons and amounts involved after which a more complete record was prepared with greater care. In this final record (for filing?) spelling was corrected; place names inserted; official introduction affixed; dates recorded; parentage noted; discounts, commissions, offerings or bonus indicated; and totals added up. Such a procedure would adequately explain the problems presented by these two texts. Though some such method on the part of scribes has been assumed, the two texts offer what seems to be direct evidence concerning this phase of Babylonian life.

In any case, it is interesting to find two tablets obviously related to each other appearing in collections several thousand miles apart and a lapse of fifteen years between their respective publication.

INTERLINEAR COMPARISON OF TEXT SC 74 AND KEISER, LCE 168

(Keiser text indicated by "k")

1. *suluppi imit eqli ša* $^{\hat{a}l}$*Su-u-tu*

   1k. .... *imit eqlêmeš ša* $^{\hat{a}l}$*La-su-ú-tu*

   2k. (*u Dûr-ša-i-*)*ti-ri makkûr* ^{d}*Innina-....*

   3k. *u* ^{d}*Na-na-a ša GIŠ.BAR ša* ^{m}*Ardi-ia a/š* ^{md}*Nabû-bâni-aḫi*

   4k. *apil* ^{m}*Ri-mut-*^{d}*Ea ša šatti 2*^{kam} ^{m}*Kam-bu-zi-ia*

   5k. *šar Bâbili*^{ki} *šar mâtâti*

2. *51 (gur)* ^{m}*La-ba-a-ši ù* ^{m}*Muk-ka-e-a*

   6k. *51 (gur)* ^{m}*La-a-ba-ši u* ^{m}*Muk-ki-e-a*

   7k. *ina libbi 5 gur ma-ak-ka-si e-lat 4 gur sis-sin-nu*

3. *60 gur* ^{m}*Šu-la-a a/š* ^{m}*Gi-mil-lu*

   8k. *60 (gur)* ^{m}*Šu-la-a a/š* ^{m}*Gi-mil-lu*

   9k. *ina lib-bi 5 gur ma*[80] *e-lat 5 gur KI-MIN*[81]

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[79] Assyrian war reliefs show scribes recording booty in the field. See H. R. H. Hall, *Babylonian and Assyrian Sculpture in the British Museum,* Pl. 26.

[80] Abbreviation for *ma-ak-ka-si.*

[81] Written *KI-2.* Semitic equivalent unknown. Means "ditto."

4. *41 gur* ^{md}*Nergal-ú-še-zib ù* ^{m}*Ardi-ia a/š* ^{md}*Innia (-na)-.... -ibni?*

10k. *(4)1 (gur)* ^{md}*Nergal-u-še-zib u* ^{m}*Ardi-ia a/š* ^{md}*Innina (-na)-šum-....*

11k. *ina libbi 4 gur ma e-lat 4 gur KI-MIN*

5. *38 gur* ^{m}*Pir-' a/š* ^{md}*Šamaš-zêr-iqîša(-ša)*

12k. *38 (gur)* ^{m}*Pir-' a/š* ^{md}*šamaš-zer-iqîša(-ša)*

13k. *ina lib-bi 4 gur MA e-lat 3 gur KI-MIN*

6. *106 (gur)* ^{md}*Innina(-na)-zêr-ušabši(-ši) u* ^{m}*Ar-rab a/š* ^{m}*Šu-la-a*

14k. *106 (gur)* ^{md}*Innina(-na)-zêr-ušabši(-ši) u* ^{m}*Ar-rab a/š* ^{m}*šu-la-a*

15k. *ina libbi 10 gur 2 pi 18 qa ma e-lat 10 gur KI-MIN*

7. *37 (gur)* ^{m}*Nûr-e-a u* ^{m}*Ni-qu-du mârê*^{meš} *ša* ^{md}*Marduk-êṭir*

16k. .... ^{m}*Nûr-e-a u* ^{m}*Ni-qu-du*

17k. .... ^{md}*Marduk-êṭir ina libbi ma....e-lat 4 gur KI-MIN*

8. *51* ^{md}*Innina(-na)-zêr-ušabši(-ši) a/š* ^{m}*Ibni-*^{d}*Ištar*

18k. ....*-zêr-ušabši(-ši) apil* ^{m}*Ibni-*^{d}*Ištar*

19k. .... *gur ma e-lat 4 gur KI-MIN*

20k. .... *napḫaru(?) ša* ^{al}*La-su-u-tu*

9. *20 gur imit eqli ša dur-ra (?)* ^{md}*Nabû-rê'û-ú-a*

10. *a/š* ^{md}*Marduk-êres(-eš)*

11. *44 ša* ^{âl}*Dûr-i-ti-ri*

21ka. *? ša* ^{âl}*Dûr-*-i-ti-ri* *(Mutilated *ša*?)

12. ^{md}*Anu-aḫ-iddin u* ^{md}*Šamaš-bêl ....*

21kb. ^{md}*Anu-aḫ-iddin*

22k. *apil* ^{md}*Bêl-aḫe*^{meš}*-êriba u* ^{md}*šamaš-bêl-ilâni*^{meš}

23k. *apil* ^{m}*Mar-duk ina libbi 4 gur 1 pi 18 qa ma e-lat 4 gur KI-MIN*

13. *3* ^{md}*Nabû-šum-iddin a/s* ^{md}*Na-....*

24k. *3* ^{md}*Nabû-šum-iddin apil* ^{md}*Na-na-a-êreš*

14. *2* ^{m}*Ba-ni-ia a/š* ^{md}....

25k. *2* ^{m}*Ba-ni-ia apil* ^{md}*Anu-aḫ-iddin UŠ.SA.DU* ^{d}*šamaš*

15. *3 (gur) 2 pi* ^{m}*Ki-na-a a/š ....*

26k. *3 (gur) 2 pi* ^{m}*Ki-na-a a/š* ^{m}*I-ba-a ina* ^{âl}*Ši-li-iḫ-ti*

16. *6 (gur)* ^{md}*Sin-ibni a/š* ^{md}*Na-na-a-êreš*

27k. *5 (gur)* ^{md}*Sin-ibni a/š* ^{md}*Na-na-a-êreš*

28k. *ina libbi ? 18 qa e-lat 1 gur sis-sin-nu e-lat ZAQ ....?*

29k. *napḫaru ša *Dûr-ša-i-ti-ri* *(alu omitted)

Translation

1. Dates, impost of the field of the city of —Sûtu
   - 1k. .... impost of the fields of the city of Lasûtu
   - 2k. and Dûr-sha-Itiri, property of Innina ....
   - 3k. and Nanâ, which is the tax of Ardîa son of Nabû-bâni-aḫi
   - 4k. son of Rîmût-Ea of/for the 2d year of Cambyses
   - 5k. king of Babylon, king of countries.

2. 51 kor Labâshi and Mukka-ea
   - 6k. 51 (kor) Lâbashi and Mukki-ea
   - 7k. out of it, 5 kor tax in addition to 4 kor date bunches (?)

3. 60 kor Shulâ son of Gimillu
   - 8k. 60 (kor) Shulâ son of Gimillu
   - 9k. out of it 5 kor tax in addition to 5 kor "ditto"

4. 41 kor Nergal-ushêzib and Ardîa son of Innina-shum-ibni
   - 10k. .1 (kor) Nergal-ushêzib and Ardiâ son of Innina-shum-...
   - 11k. out of it 4 kor tax in addition to 4 kor "ditto"

5. 38 kor Pir' son of Shamash-zêr-iqîsha
   - 12k. 38 (kor) Pir' son of Shamash-zêr-iqîsha
   - 13k. out of it 4 kor tax in addition to 3 kor "ditto"

6. 106 kor Innina-zêr-ushabshi and Arrab son of Shulâ
   - 14k. 106 (kor) Innina-zêr-ushabshi and Arrab son of Shulâ
   - 15k. out of it 10 kor 2 pi 18 qa tax in addition to 10 kor "ditto"

7. 37 (kor) Nûrêa and Niqudu sons of Marduk-êṭir.
   - 16k. .... Nûrêa and Niqudu
   - 17k. .... Marduk-êtir, out of it .... in addition to 4 kor "ditto"

8. 51 Innina-zêr-ushabshi son of Ibni-Ishtar
   - 18k. ....-zêr-ushabshi son of Ibni-Ishtar
   - 19k. .... kor tax, in addition to 4 kor "ditto"
   - 20k. .... total of the city of Lasûtu

9. 20 kor impost of the field of durra (?) grain Nabû-rê'ûa

10. son of Marduk-êresh

11. 44 of the city of Dûr-itiri
    - 21ka. ? of the city of Dûr-itiri

12. Anu-aḫ-iddin and Shamash bêl-ilâni
    - 21kb. Anu-aḫ-iddin
    - 22k. son of Bêl-aḫê-êriba and Shamash-bêl-ilâni
    - 23k. son of Marduk, out of it 4 kor 1 pi 18 qa tax, plus 4 kor "ditto"

13. 3 (kor) Nabu-shum-iddin son of Nanâ-êresh

24k. 3 (kor) Nabû-shum-iddin son of Nanâ-êresh

14. 2 (kor) Banîa son of ....

25k. 2 (kor) Banîa son of Anu-aḫ-iddin, adjoining the Shamash (field?)

15. 3 (kor) 2 pi Kinâ son of ....

26k. 3 (kor) 2 pi Kinâ son of Ibâ, in the city of Shiliḫti

16. 6 (kor) Sin-ibni son of Nanâ-êresh

27k. 5 (kor) Sin-ibni son of Nanâ-êresh

28k. out of it .... 18 qa plus 1 kor date bunches, plus impost ....

29k. Total of (the city of) Dûr-sha-itiri

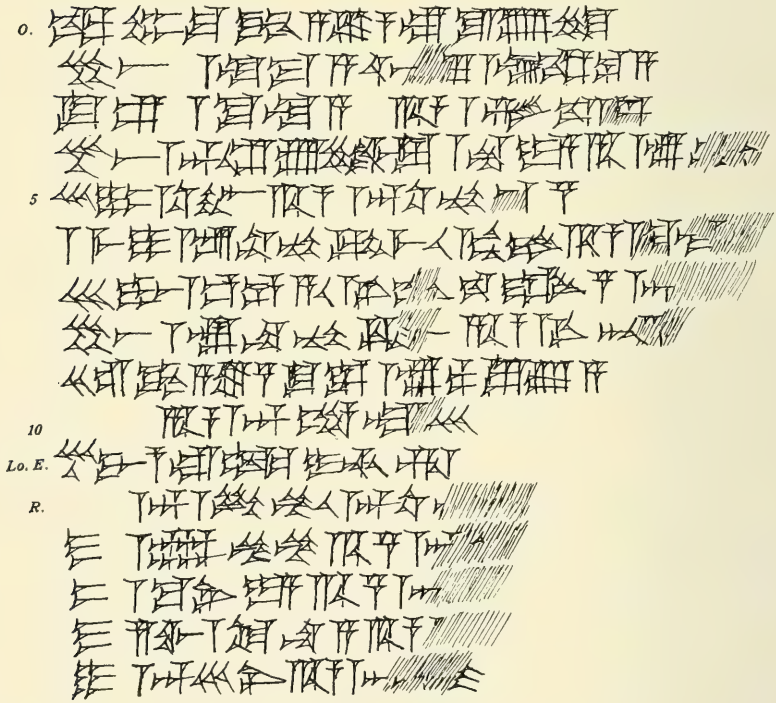


PLATE XVIII.

A scribe's notes from which a more complete document was later drawn. This tablet, SC 74, reposes in the Welch collection while its counterpart lies in the Jas. B. Nies collection over three thousand miles away. Filed in ancient Erech, dug up, brought to America, separated by a continent, after fifteen years the two documents are now coördinated through publication.

N.B.— Errata: Plate X, line 4, the fourth sign copied as *qa* is probably the *qit* sign instead. Tablet badly flaked at this point. Copyist omitted the vertical wedge determinative before the proper names Shalti-ilani (Pl. X, line 11) and Gimillu (Pl. XIV, line 14).

NOTES ON THE LIFE HISTORIES OF FOUR CALIFORNIAN LEPIDOPTEROUS INSECTS

By John A. Comstock and Charles M. Dammers

Incisalia iroides Bdv.

This species is one of the early spring butterflies in southern California, and is common in its season throughout the state. It is usually found flying in close proximity to *Rhus* or *Eriogonum,* which had led our collectors to suspect one or the other of these genera as its food plant. Close observation for many past years by a host of lepidopterists has failed to unravel the mystery.

In March of 1932 the junior author of this paper, together with Mrs. Dammers, discovered that the usual food plant is *Cuscuta* (Dodder) and that the butterfly usually deposits its eggs on the host plant in close association with the parasite. This discovery made possible the description of the following life history of the Western Elfin.

Egg. Echinoid, with a depressed micropyle, somewhat suggesting the egg of a *Plebejus* rather than one of the Theclinae. The surface is covered by a fine reticulation of raised walls, enclosing irregular hexagonal cells, very much as in the egg of *Strymon melinus.* The points of juncture of the cell walls show only a slight tendency to develop raised papillae. Color, a rich jade-green. The eggs are deposited singly. Illustrated on Plate 19.

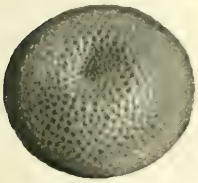


PLATE 19

Egg of *Incisalia iroides,* highly magnified.

Larva.

First instar; slug shaped. Ground color, yellowish green, with a broad band of yellow mid-dorsally and laterally. Abdomen and all legs, yellowish green. There are four rows of stiff brown hairs, as with most young larva of the group, one hair to each segment in the row. Head, colorless.

Second instar. Very similar to first, but the body becomes more thickly covered with stiff brown hairs. See Plate 20.

Successive instars. Ground color, apple-green. Sub-dorsally from the second to the tenth segments there is a line of yellowish white bars with a diagonal elongation from their fore ends extending downwards and backwards, one to each segment, that on the third being slightly tinged with red, while the one on fourth segment is almost entirely red. The overlap or substigmatal fold is yellow. Spiracles, green, with a brown rim. Abdomen, pale green. Legs, colorless. Prolegs, and anal prolegs, pale green.

PLATE 20

Larva of *Incisalia iroides*, 2nd instar, feeding on Dodder. Magnified x 22.

Drawing by C. M. Dammers.

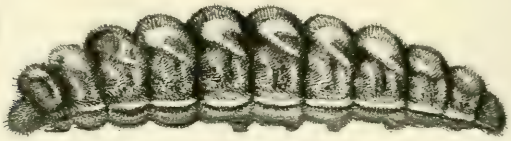
Head, colorless, with the mouth parts brown. Cervical shield, reddish.

The whole insect is covered with minute short brown pile.

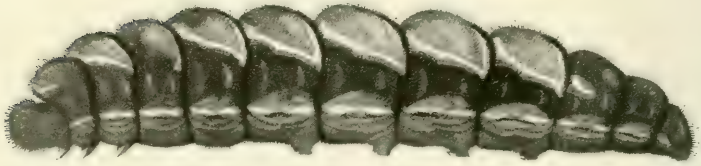
Mature larva. Extended, length 16 mm.

There is considerable variation in the color. Some individuals retain the general color pattern of previous instars, others are olive, while a number are light green. The olive type may be described as follows:

Ground color, olive. On each segment from the second to the tenth, subdorsally placed, there is a raised triangular area. bordered on its lower and rear edges with a white band (except on the fourth, which lacks the white edging). These areas are not



a.



b.

PLATE 21

Larva of *Incisalia iroides*.

a. Intermediate stage, magnified x 12.
b. Mature larva, enlarged x 6.

Drawings by C. M. Dammers.

as pronounced on the second and tenth segments as on the others. Sub-stigmatal fold, white, with raised red blotches at center of each segment. Cervical shield, pale mauve. First segment, dark mauve. Spiracles, green with brown rims. Abdomen, pale green with a red blotch on center of each segment just below the overlap. Legs, colorless. Prolegs and anal prolegs, green with pale green claspers. Head, colorless, with white and brown mouth parts.

The entire insect is covered with minute brown pile.

The mature larva, and also one in an intermediate phase is shown on Plate 21. Pupation took place on the host plant, apparently without any attachment.

Pupa. Length, 9 mm.

Head, thorax and wing cases, pale brown. Body, bright chestnut. The thorax and wing cases are speckled with black. There are seven longitudinal lines of black blotches or spots on the body, placed as shown in the illustration, Plate 22.

The same character of short brown pile covers the chrysalis, except for the wing cases and facial portions.

Eggs were taken from the 5th to the 20th of March.

The first larva pupated April 14.

The first imago emerged May 10.

Carl W. Kirkwood of Santa Barbara reports breeding this species on flowers of a *Ceanothus* in 1932.

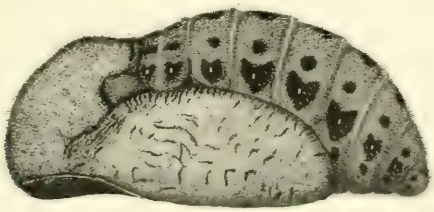


PLATE 22
Pupa of *Incisalia iroides*, lateral view, enlarged x 6.
Drawing by C. M. Dammers.

PLEBEJUS NEURONA Skin.

This small, and very distinctively marked "blue" is taken at high elevations in the mountains of southern California in the early to mid-summer. It occurs in isolated colonies, in association with *Eriogonum wrightii* Torr., its food-plant.

Eggs were secured from captive females taken at Blue Ridge, above Wrightwood, San Bernardino County, on June 8, 1932.

Egg: Size, about .6 mm. in diameter x .2 mm. high.

Color, appearing as white, but under magnification showing a delicate grayish green. The form is of the usual echinoid, with a depressed upper surface or shallow crater, in the center of which is a minute micropyle. The latter is not very deep.

The surface of the egg is covered with a fine reticulation of low raised walls, which are delicate white, and which enclose irregular depressed cells. At the points of juncture of the walls are poorly defined tubercles, as with most Lycaenid eggs.

Eggs collected on June 8 hatched on the 17th.

Larva.

First instar: pale greenish yellow, speckled white. There are the usual four rows of long hairs. These are white, and slightly recurved posteriorly. Head, black.

Successive instars; slug-shaped; the body, including abdomen, pale green. There are two parallel pale lines along the mid-dorsum, and also two similarly colored diagonal lines on each side, crossing the segments, except the first. The overlap is white. Legs, pale green, with brown points. Prolegs and anal prolegs, pale green with light brown claspers. Spiracles, white. Head, black. The body is covered with long white pile, each hair of which arises from a silvery white point.

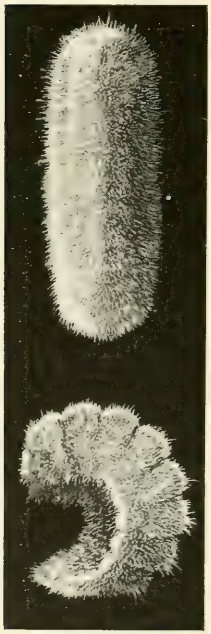


PLATE 23

Mature larva of *Plebejus neurona*, enlarged x 5.

Mature larva; extended length, 7.5 mm. Color, gray-green, the integument being light apple-green, with a profuse white pile which gives the suggestion of a gray overcast. Each hair arises as before, from a white protrusion. There is an indistinct dark mid-dorsal line which is best developed in the region of the 5th to 8th segments, and which fades out anteriorly and posteriorly. This is edged laterally with a cream colored line, more clearly defined posteriorly. The broad white diagonal lateral bands are still present, except on the first segment. Overlap, white, or pale buff. Legs, green, with pale brown points. Prolegs, and anal prolegs, green, with pinkish brown claspers. Spiracles, soiled white, and inconspicuous. Head, black, and retractile.

This larva does not taper anteriorly and posteriorly to the same extent as with most other species. It is illustrated in Plate 23. Pupation occurs on the food plant, with the usual silk button for the cremasteric attachment, and a delicate silk girdle. The fiirst specimen pupated July 28.

Pupa. Length 6 mm.

Head and thorax, vivid green, merging into a lighter yellowish green on the terminal segments. Wing cases, bluish gray. Stigmata, minute, yellowish-brown centered. Cremasteric hooks few in number, very short and slightly darker than body.

There is some variation in the color of pupa.

A few very minute brownish vibrissae occur about the head and around the spiracles, otherwise the body is free of appendages, and gives the appearance of being smooth and hairless.

The first imago emerged August 6, and specimens continued to hatch thereafter, which indicates a second brood. Mr. Chris Henne reports the species at the base of Sugar Loaf Mt., San Bernardino Co., in August, 1932, which further confirms a double brood.

The pupa is illustrated on Plate 24.

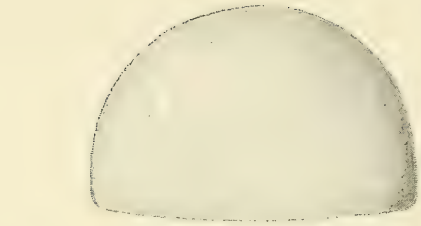
PLATE 24

Pupa of *Plebejus neurona*, dorsal, lateral and ventral aspects, enlarged x 6.

———o———

HYLEPHILA PHYLAEUS Dru.

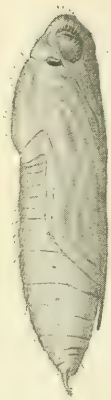
The metamorphosis of this species was recorded in great detail by Karl Coolidge, in Vol. 50 of the "Transactions, American Entomological Society." This paper was not illustrated, and we consider it of value therefore to include drawings of the egg, mature larva and pupa, as shown on Plate 25.



a.

b.

c.



d.

PLATE 25

Early stages of *Hylephila phylaeus.*

a. Egg, magnified x 40.

b. Mature larva, enlarged x 2½

c. and *d.* Pupa, enlarged x 3.

Drawings by J. A. Comstock.

———o———

GRAEPERIA ALTERA Sm.

Larvae of this species were collected at Shaver's Wells, near Indio, California, in 1931, feeding on a species of *Ericameria,* and were bred to maturity. The same caterpillar was also encountered in the Antelope Valley in June, 1932, on the same plant. The larva shows great variation, ranging in color from a light green with darker lines, to an olive with blackish brown lines. The description and illustration are made from the darker type.

Mature larva; average length about 22 mm. Of the long, cylindrical "looper" type. Ground color, olive.

The body bears numerous longitudinal dark bands. There is a double median-dorsal band of dark brown, bordered laterally with a light cream or olive area containing a suggestion of two light brown discontinuous bands. Lateral to this is a darker area containing approximately three dark brown bands, the middle one of which is fairly constant. Inferior to this area is a broken and somewhat lobulated raised band, placed stigmatally, and lighter in color than any other area.

Head, cream-colored, with brown spots and streaks. Ocelli, brown. Mouthparts concolorous with head. A few short bristles occur on the face, and body. Abdomen, a shade lighter than the dorsum, and banded with more or less broken longitudinal lines, of a light brown. True legs of the same shade as abdomen, except for the dark brown tips. Prolegs and anal prolegs concolorous with abdomen. See Plate 26.

PLATE 26

Mature larva of *Graeperia altera*, enlarged x 2½.

Drawing by J. A. Comstock.

Pupa: 6.5 mm. long x 2.4 mm. wide through thorax. Body surface smooth, and free of all appendages. Predominant color, green, the abdominal segments laved with straw, and the segmental creases green. Head, tinged with brown. Eye cases prominent, bearing three small black punctae. Wing cases translucent showing the segmental lines underneath. Abdomen gradually tapering to a rounded tip. Stigmata minute, brown. Cremasteric hooks, 2 in number, short and brown. The pupa is illustrated on Plate 27.

PLATE 27

Pupa of *Graeperia altera*, dorsal, lateral and ventral aspects. Enlarged x 5.

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To be used when it is desired to leave the Academy any personal property, such as money, stocks, bonds, works of art, or other objects of value.

I give and bequeath unto "Southern California Academy of Sciences," of the City of Los Angeles, the sum of..... Dollars: To have and possess the same unto the said "Southern California Academy of Sciences," its successors and assigns, to the uses, dispositions and benefits thereof forever.

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■ ■

Bulletin of the
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Began issue with Vol. I, No. 1, January, 1902. Issued ten numbers in 1902, nine numbers in 1903, 1904, 1905; three numbers in 1906. Issued two numbers annually from 1907 to 1919, both inclusive (except 1908—one issue only). Issued four numbers (January, May, July and October) in 1920.

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The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

The 1923 issues are: Vol. XXII, No. 1, March; No. 2, July.

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"	12,	"	1.	January,	1913	.50
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"	23,	"	4.	July,	1924	.25
"	23,	"	5.	September,	1924	.25
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"	24,	"	2.	May,	1925	.25
"	24,	"	3.	September,	1925	.25
"	25,	"	1.	January,	1926	.75
"	25,	"	2.	May,	1926	.25
"	25,	"	3.	September,	1926	.25
"	26,	"	1.	January,	1927	.25
"	26,	"	2.	April,	1927	.25
"	26,	"	3.	September,	1927	.25
"	27,	"	1.	January,	1928	.25
"	27,	"	2.	May,	1928	.25
"	27,	"	3.	September,	1928	.25
"	28,	"	1.	January,	1929	.25
"	28,	"	2.	May,	1929	.25
"	28,	"	3.	September,	1929	.50
"	29,	"	1.	January,	1930	.25
"	29,	"	2.	May,	1930	.25
"	29,	"	3.	September,	1930	.25
"	30,	"	1.	January,	1931	.25
"	30,	"	2.	May,	1931	.25
"	30,	"	3.	September,	1931	.25
"	31,	"	1.	January,	1932	.25
"	31,	"	2.	May,	1932	.25
"	31,	"	3.	September,	1932	.25
"	32,	"	1.	January,	1933	.25
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Vol. XXXII September - December, 1933 Part 3.

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Issued Sept. 30, 1933

Southern California Academy of Sciences

ANCIENT HOUSES OF MODERN MEXICO

By Arthur Woodward

During a trip into northern Sonora in June, 1932, the writer encountered a small, deserted encampment left by the soldier-laborers engaged in the construction of the Altar-Sonoita highway which revealed many interesting features of pit house and flimsy surface structures, comparable to many of the ancient forms of habitations, the ruins of which are encountered in many parts of our own Southwest, particularly in Arizona and New Mexico.

The author, in common with many other field workers, has encountered or seen many puzzling features of architectural construction left by the ancients, especially on those sites whereon the perishable superstructures had either fallen to decay or had gone down in some unknown holacaust. The chance "discovery" of this modern Mexican pit house village with its accompanying surface structures and evidences of household debris was very illuminating in that it served as an excellent text book with photographic illustrations of the habitations of people dead these many long centuries. The study of the details of the construction of the various types of shelters represented in the group gave one the odd feeling that here, in the midst of this dry Sonora wasteland, a group of pre-historic people had suddenly appeared from the hazy horizon of the past, built their homes, lived peacefully for a few weeks and then, as must have been their wont, moved on, leaving their houses standing for the special benefit of a modern investigator (Pl. 28).

PLATE 28

Here were houses in good condition, untouched by the fingers of decay. Here was all of the miscellaneous debris of a migrant people abandoned to the elements. Here were the out-of-doors cooking hearths, the wind shelters, sun shades (Pl. 40), broken pottery, the remnants of meals, bones, wind blown corn meal and a few broken stone implements. All in all it was a perfect combination for an archeologist seeking accurate knowledge of the appearance of a combination pit and surface structure village as it must have been those decades of centuries ago when such communities were common in the southwestern portion of the United States.

The shelters in question had been erected and used as winter quarters by the soldiers of the 39th Battalion of Infantry and the 15th Regiment of Cavalry of the Mexican regular army during the months of November and December, 1931, and January and February, 1932, during which time the troops were employed on the preliminary *"pico y palo"* (pick and shovel) work on the new highway between Caborca and Sonoita.

Later these troops moved to another camp between the towns of Santa Ana and Magdalena where they were busily engaged in an excellent bit of highway construction when the writer saw them in June, 1932. Unfortunately, from a student's point of view at least, the government had supplied the troops with new tents to be used as summer quarters and the opportunity to view the families actually inhabiting the pit dwellings was lost.

However, the evidence of the deserted encampment, which was scattered along both sides of the road for some two or three miles between the little wayside villages of Quitovac and San Pedro, was circumstantial enough to present a very clear picture of what had happened, and I believe the photographs, cross sectional views and descriptions of the houses will speak for themselves.

Before entering upon a discussion of the site, the writer wishes to emphasize the fact that, although many questions of structural detail of ancient pit structures seem to be clarified in these modern examples, the reader should not construe this article as a complete solution for *all* pit house construction. These modern pit houses and surface shelters certainly duplicate many of the features embodied in the remnants of such habitations which have been discovered in various parts of the Gila valley and the Flagstaff region in recent years, but there are other types reported by workers in the field which do not tally with these descriptions. The term "pit houses" evokes many mental images, many of them special regional adaptations, and this should be remembered by all who read this account.

There were between seventy-five and one hundred of these shelters. They varied in size, according to the number of persons occupying them. Many of the soldiers had their families with them. Others were bachelors. There were houses built to accommodate families. These were usually snug, well built affairs. Others were mere holes in the ground, the sleeping quarters of

single men. Evidences of the families were scattered about the camp. Here were the cast off, bright red shoes of women and children. Many torn, discarded military caps of olive drab were also in evidence.

Fourteen of the shelters, including the most common varieties of both the pit and surface structures were measured and photographed.

The materials used in the construction of the surface habitations, and in the roofings of the pit dwellings were all native to the region. No modern materials such as tin, canvas, wire, or nails entered into the construction of the houses.

The uprights were of *palo verde,* the ridge poles were either of *palo verde* or *ocotillo* stalks. The ribs of the giant *sahuaro,* sectional slabs of the organ cactus, brush and earth formed the roofing material. The framework of the tent-like roofs on both types of houses consisted of *ocotilla* stems resting against the sturdier ridge poles of *palo verde* or the heavy ribs of the *sahuaro.*

The structures were of two main types, surface brush shelters, termed *jacales* in Mexico, and the regular pit house consisting of either an oval or rectangular pit dug into the hard soil to a depth ranging from 9 inches to 3 feet and roofed with *ocotillo* stalks, brush and earth.

This roofing was tent shaped in most instances and the method of construction was simplicity itself.

In discussing the various features of this encampment no attempt will be made to describe in minute detail every house encountered. The salient points of construction will be noted and measurements of a few of the houses will be given. A table of measurements for the shelters which were specifically chosen for study at the time is appended to this article.

PLATE 29

House No. 1 happened to be a surface structure in excellent condition. (Pls. 29, 29-*a*.)

This habitation was 5 feet 10 inches in width (interior measurements) and 7 feet 6 inches in length. Two crotched uprights of *palo verde*, each 4 feet 9 inches in height supported a ridge pole 7 feet 6 inches in length. Leaning against this ridge pole, the butt ends resting on the earth, were a number of *palo verde* and *ocotillo* side poles. The entrance, facing east, was uncovered. In fact, the majority of these houses were entirely open at one end, or only partially closed, and with one or two exceptions had no portable door covering.

The rear of the house was constructed of *ocotillo* stalks, the upper ends resting in the crotch of the rear upright post and against the end of the ridge pole, the butt ends resting on the ground in such a fashion as to make a semi-circle. Cross rods of *ocotillo* were lashed to the side poles and over the cross poles was laid a matting of brush. The entire structure was then coated with earth. The earth was banked around the base of the house to a depth of 30 inches while the roof covering proper was from 5

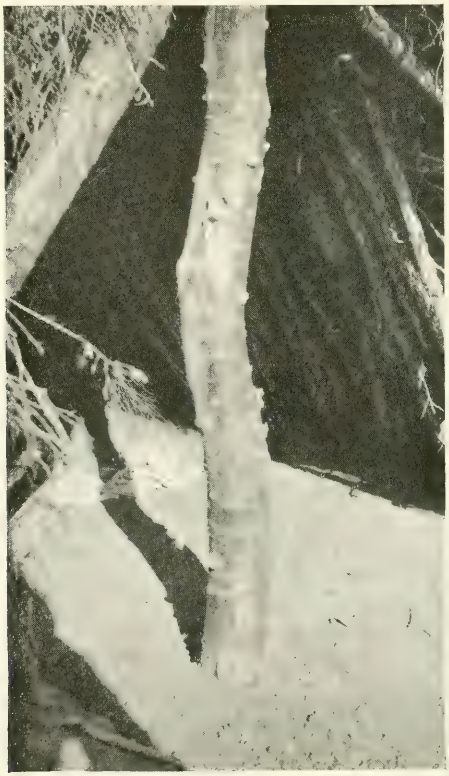

PLATE 29-*a*

to 6 inches deep. In fact the banked earth flowed around on either side of the open end, forming small talus slopes which of course restricted the opening and at the same time aided in diverting water from the house during winter storms.

The upright posts supporting the ridge pole were 4½ to 5 inches in diameter. The ridge pole was 4 to 5 inches in diameter while the side poles varied from 4 to 5 inches for the *palo verde* and 2 inches for the *ocotillo*.

In the majority of the houses the side walls were of *ocotillo* stems, but occasionally as in this hut, nine pieces of *palo verde* were used.

Ordinarily the strongest *palo verde* timbers were placed at the front, rear and on the sides, which arrangement made a sturdy framework and prevented sagging of the sides when the brush and earth were laid upon the cross rods. *Ocotillo* stems, when used alone, being more limber, had a tendency to sag and cause the house to cave in more quickly than those structures where heavier timbers were used.

The floor of House No. 1 was smooth but not surfaced in any manner. In two or three instances surfaced floors were noted, i.e., small gravel had been brought in and tamped down. However, in the main no attempt was made to better the flooring other than to wet it and tamp it, or as in most cases, leave the natural earth to be trodden smooth by the feet of the occupants.

Although this house served admirably as an illustration for one type of the surface structures encountered it did not have one feature which characterized some of the shelters, which feature seems rather important to record for the simple reason that it has occurred over a wide area in the Southwest in connection with the ruins of both pit and surface houses.

I refer to the outlining of the floor with a single line of stones not bound together with mortar nor serving as regular wall of any kind (Pl. 41).

The majority of field workers who have been doing such excellent work in the Southwest, Colton,[1] Monroe Amsden,[2] Haury,[3] Bradfield,[4] and others have mentioned this feature.

The writer, while working as an associate of Dr. Van Bergen on an archeological survey of the Gila Valley, east of Florence, Arizona, to the San Pedro river in 1930, and likewise on a similar survey of sites on the Fort Apache Reservation in 1931, during which period the Van Bergen - Los Angeles Museum party, maintained by Dr. Van Bergen, with Mr. Ben Wetherill as reconnaissance scout, observed numerous remains of surface *jacales* and pit houses having this rock outline feature.

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[1] Colton, H. S.; *Prehistoric Sites in the Region of Flagstaff*, Bulletin 104, B. A. E.; Washington, D. C., 1932.
[2] Amsden, Monroe; *Archeological Reconnaissance in Sonora*, Southwest Museum Papers No. 1, p. 47; Los Angeles, 1928.
[3] Haury, Emil; *Roosevelt 9:6, a Hohokam Site of the Colonial Period, Gila Pueblo, Globe, Ariz.*, Aug., 1932.
[4] Bradfield, Wesley; *Cameron Creek Village, Santa Fe, N. M.*, 1931.

Test excavations of such sites were made, particularly on Midway Site No. 1, a point three miles north of the main highway between Florence and Tucson, halfway between those places.

In those remains which were studied at first hand by the writer, the features of the ancient houses correspond exactly with the modern houses encountered in Sonora.

As a rule, when first encountered, these small, rectangular or semi-rectangular outlines of small stones set flush with the present surface of the ground or buried a few inches beneath the soil, present somewhat of an enigma to the archeologist. It is often difficult to tell whether the structure in question was a surface or pit dwelling. However, a test pit usually tells the tale. Often, in the case of surface houses, the ruined floor is speedily discovered a few inches under the top surface, or it may be that the floor, if it was unplastered or otherwise unsurfaced, has almost entirely disintegrated. In that case digging is futile. However, when a pit house is encountered, the character of the fill reveals the presence of the pit and a cross trench usually ends at the walls; the rest is simple.

In times past, while in the field, we have advanced various theories concerning the use of these stones. Some deductions were fairly accurate, the others were just guesses. Usually these stones have been found too far apart to serve as a wall, and the utter absence of other stones of a similar size precluded their use as the lower course of a small retaining wall, nor in such cases was there any sign of a binding mortar.

However, in the Sonora encampment, the use of such stones was convincingly revealed. Whether or not the ancients used them in the same manner is for the reader to decide. The fact remains that in many cases, the modern pit and surface dwellings, when stripped of their superstructures, tallied point by point in their features of construction with some of the oldest of the same types of houses encountered in the Southwest.

In the modern shelters the stones served two different purposes.

Several of the surface structures had these stones set along the periphery of the floor. These stones were rather small flat ones from 6 to 8 inches in diameter, and 2 or 3 inches thick. They were not laid one against the other, even as in the older prototypes. These rocks were laid outside the line of the butt ends of the poles acting as side walls, the lower ends of the posts in many instances rested against the rocks. There were one or two instances of two rows of rocks being used with the butt ends of the side poles resting between them. These rocks therefore served as ground braces for the poles and at the same time served as a nuclear core for the heavy earthen base of the house, preventing the initial deposits of dirt from sliding away from the base of the poles.

The stones outlining the pit houses functioned a bit differently.

Instead of acting as a basic core for the earthen bank, they served as a solid foundation upon which the *ocotillo* side poles rested. By placing the butt ends of these rather slender roof supports upon the stones, the builders prevented the poles from settling into the earth when the overload of brush and earth was added.

In Plate 30, a cross sectional view of this type of a structure is shown, indicating the use of the stones as butt supports. Plate No. 31 shows a surface structure going to decay with the stone outline partially covered by earth.

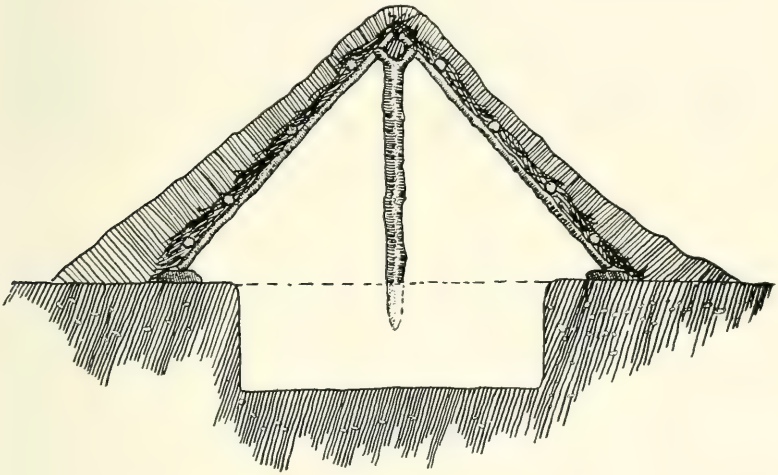

PLATE 30

Let us consider a moment the aspect of these dwellings as they begin to disintegrate. Archeologists (save in exceptionally favorable circumstances) are compelled to utilize only the rudimentary remains of material culture in reconstructing certain phases of the lives of the ancients. However, in the case of the modern pit village, we have the reverse. Here are the houses complete or in various stages of decay. It is not difficult to postulate their appearance some years hence, and by combining the complete picture with the fragmentary sketch, we achieve somewhat the effect of superimposed films, making as it were a double exposure. With the knowledge obtained from excavations on prehistoric sites, it is a comparatively easy matter to reverse our deductions. In other words, we can easily use the present to postulate the future by using facts obtained in excavation of ancient sites.

Even at the time of "discovery" of the Sonoran encampment, some of the less sturdily constructed shelters were either falling into ruin through the careless selection of poor building materials, too slender branches of trees, or rotten *sahuaro* ribs, or had been

PLATE 31

accidentally burned down by the inhabitants. Wood borers were at work in the dry *palo verde* supports. One could put one's ear to the posts and hear the busy insects at work in the heart of the timber. In a few years hence that entire village will be a mass of ruins and fast melting into the earth from whence it sprang. And, as the houses crumple, this will happen:

In the case of the surface structures, the ridge pole breaking, or one of the crotched uprights tilting, will bring the roof down upon the floor in a shapeless mass. The brush and light cross rods will decay. If the roof has not been covered with earth, the light brushy covering will disintegrate and blow away, and unless the floor happens to be outlined with stones, no visible evidence of that house will remain for future archeologists. However, if the house has been covered with earth, wet down and plastered smooth, the chances are, this roof crust will pack into a low, uneven mound, and unless subjected to unusual climatic conditions, either extreme moisture or snow fall, this mounded ruin will remain thus for many years, and the stones outlining the floor will be partially covered. If the house is located at the base of even a gentle slope, in time the rain-washed detritus will bury it deeper and deeper. It may be that one side of the house will sag more quickly than the other. The weight of the side pieces will press heavily upon the opposite side of the house, and thus, when the collapse occurs, one side will be buried under a double layer of debris, and one row of stones will be exposed cleanly at the time of dissolution. An example of this is shown in Pl. 31.

When a pit house decays or is burned the effect is a bit different, and luckily for the archaeologist, a trifle more satisfying in the ultimate results (Pl. 32).

PLATE 32

In such instances, the collapse of an earth-covered roof precipitates the bulk of the debris directly into the hole, with the exception of the heavier banks of earth on the periphery of the pit. As the earth sinks into the confines of the pit, and the light brush and poles break and rot, the earth tends to pack as it settles. In time, the banks of earth on the edges of the pit gradually waste away, part of the ridges slide into the pit, now a rather slight depression in the ground, the remainder becoming *aeolian loess*. As the years advance, the concavity that was a pit collects the rain water in the wet seasons. During the dry months, sand and dried vegetation blows into the sink. Succeeding rains pack this layer into a thin line of silt. This process continues until the pit becomes level with the surface and the stones outlining the house are the only imperishable evidence of that which lies beneath.

The picture I have drawn of this disintegration is not a mythical one. It is as I have said, a combination of modern conditions and pre-historic findings.

We have already discussed some of the main features of the surface shelters and indicated some of the aspects of the pit dwellings. Let us now consider some of the modern parallels of pit house construction and a few general observations which seem to have counterparts in many prehistoric sites.

Often, in certain types of pit houses found in the Gila Valley and elsewhere in the Southwest, there were few evidences of roof support. That is, the absence of post holes in the floors of the dwellings seemed rather peculiar. Sometimes none were observed although the floors and sides of the pits were well fashioned, and in some instances neatly plastered.

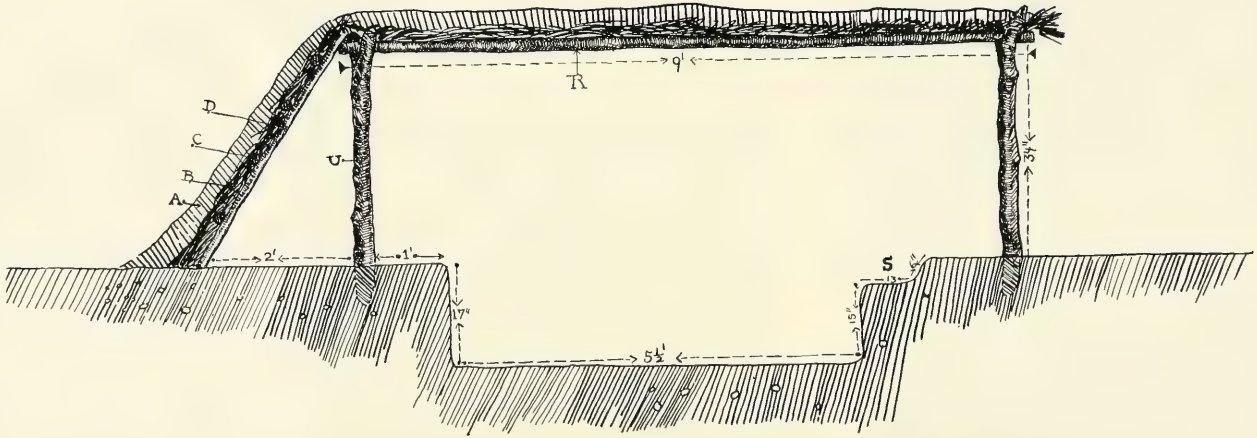

PLATE 33

LEGEND

A—Earth B—Brush C—Cross rods D—Side Poles U—Uprights R—Ridge poles

The writer encountered two or three such pit dwellings while excavating upon a compound site located on the ranch of Mr. A. J. Christensen, two miles east of the Casa Grande National Monument, in the spring of 1929.

Among the pit houses in Sonora were some which were almost identical counterparts of those Hohokam dwellings.

The cross-sectional view in Pl. 33 illustrates the principle upon which this type of habitation was constructed.

The main crotched supporting poles upholding the longitudinal roof tree were sunk in the earth outside the pit. The house was then covered in the usual manner. Thus there were no obstructions within the pit house proper, and the pit itself was in fact but a portion of the house. The roof covered considerably more of an area and gave the residents a chance to utilize the surface level as a shelf. Houses of this type are deceptive when viewed from the outside. In fact, the majority of the pit houses shown in the photographs appear smaller than they actually are.

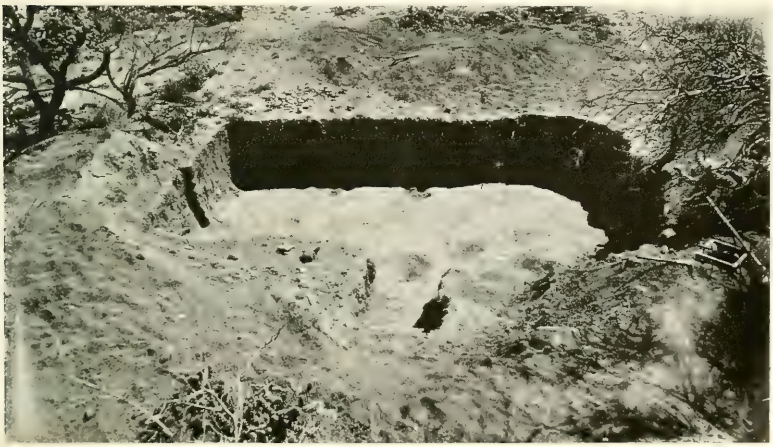

PLATE 34

Pit House No. 1, Midway Site, excavated by Van Bergen - Los Angeles Museum Party in 1931. Note post hole at end of pit. A similar hole was found at the opposite end of the floor. In effect this ancient dwelling was almost the counterpart of the side entrance structure found in Sonora (see Plate 33). Observe entrance way and fire pit in floor.

Again, the majority of the houses had but two main uprights which were sunk, one at either end of the dwelling, centered and flush with the end walls. In such cases, when the house decays these two post holes will remain. Houses of this type were encountered at the Midway Site No. 1, already mentioned. Pl. 34 shows one of the best examples of such a house excavated at that site.

However, in the Sonora village one house presented a different picture. The roof was upheld by seven *palo verde* timbers, and of these seven supports but five were in the pit itself. Pl. 35 illustrates the method of construction of this house.

It will be noted that this structure is rather oddly built. Instead of the side poles of both sides resting on ridge pole and the stone butt supports, the uprights sunk in the pit along the sides of the walls, uphold longitudinal side poles (A) which give additional support to the rafters. Both of the end supports are sunk in the earth outside the pit.

In this house is an interesting illustration of house construction, which, if uncovered on a pre-historic site might possibly lead to a false postulation.

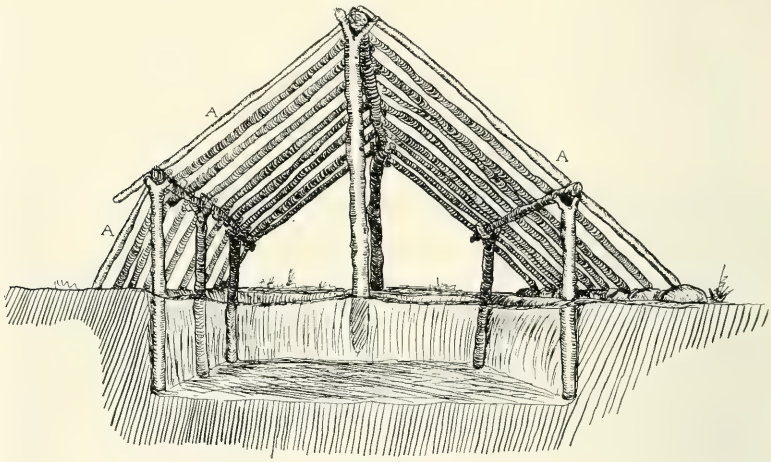

PLATE 35

An archeologist finding the five post holes in the floor and noting the five grooves along the side walls might think that the posts, being stout ones, had projected into the air higher than they actually did, and that the roof was flat. Instead, these posts projected relatively a short distance above the surface level and acted as supports for the regular, slanting, tent-shaped roof. However, the builder of this house either miscalculated the length of the poles on one side of his dwelling or was unable to secure poles of a length equal to those used on the other side and was forced to throw up a second row of short poles on one side, thus producing an odd, lop-sided effect to his building, more noticeable on the inside than on the outside of the structure. This building was (pit measurements) 7 feet long, 6½ feet wide and 20 inches deep. The end posts were sunk in the soil, 11 inches from the edge of the pit while the side poles rested on their stone supports, on one side only, some 15 inches from the pit edge.

The question of entrances in pre-historic pit dwellings differs of course with the areas in which they are found and the individual examples uncovered as well as the postulated reconstructions made by the excavators. Some of the ancient dwellings show no visible means of ingress and egress. Others have decided steps cut in one side of the pit wall. The pit houses in Sonora were of both types.

The majority of the Mexican dwellings however had no steps. Even in those which had them, the steps were quite rudimentary. A cross section of a house having a step is shown in Pl. 33.

As indicated in the photographs, most of the houses were entered from one end, which was left either entirely open or only partially closed. A few entrances were on the side of the dwelling. Pl. 36 shows one house of this type and immediately adjacent to it is a dwelling entered from the end. The side entrance house in this case had a slight step cut in the bank.

PLATE 36

One house had a triangular door, simply and rudely constructed (Pl. 37). During the period of occupancy some of the other habitations may possibly have had mat or blanket door coverings but there were none in evidence when these notes were made.

Only one example of a dwelling was noted to be open at both ends. This house (Pl. 38) was also different in another respect. Although a pit 7 feet long, 5 feet wide and 9 inches deep had been dug, only a portion of the excavation had been roofed and instead of a straight upright at the entrance a curved one was used.

Various aspects of this 20th century pit house village were interesting in that they gave intelligible interpretations of apparently similar phases of the earlier communities.

PLATE 37

Often while digging on a site sundry patches of charcoal, small pits filled with ashes or showing signs of having had fire in them, burned stones and other camp debris are encountered.

This modern site was replete with these incidentals.

The fact that the Mexican soldiers had their families with them gave to this settlement an air of authenticity which it would not have had if the men had all been bachelors, or if the camp had been occupied but a few days.

The evidences of domesticity were so apparent that one could not help being impressed by them. The discarded shoes, scraps of feminine finery, broken toys, and shattered pottery spoke with mute voices, and save for their modernity must have been replaced with similar perishable items in the long-ago towns.

Open-air fireplaces over which the family meals were cooked have been in vogue for centuries. Very few of the dwellings had hearths in them, and those few were apparently used for heating the domiciles on nippy days. The absence of these fire pits in the huts was the one major difference between these houses and those of the ancients.

However, even the Hohokam of the Gila used open-air pits presumably for cooking, and the presence of caliche trivets as well as fire-burned stones on the Grew site[1] outside the ruined houses gives ample evidence that the Old People also had open-air kitchens.

The majority of the houses were covered with the tawny soil of Sonora. Some of the exteriors were dampened and smoothed into a rude plaster (Pl. 39). Others had the earth heaped upon them without further ceremony or any procedure other than piling it on the brush covering the side poles.

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[1] Woodward, Arthur; *The Grewe Site*, Occasional Papers No. 1, Los Angeles Museum, 1931.

PLATE 38

A few of the huts were albinistic and gave the appearance of having been coated with whitewash. Closer examination revealed the fact that these dwellings were coated with wood ashes (Pl. 39).

This simple discovery clarified one of the little archeological problems frequently encountered in the course of excavating on the old pit house sites. Now and then in digging we have found thin lines of ash and charcoal in the roof debris of a collapsed pit dwelling, yet to all appearances that particular hut had never been burned. If one may apply the present interpretation of the ash-coated roofs to the pre-historic problem, the question of the mysterious ash lenses is solved.

Presumably this wood ash placed on the roof acts as a thin plaster when wet and aids in keeping the roof rain-proof. I say presumably, for although the explanation seems logical, it may be that the inhabitants threw the ashes on the roof as a convenient method of getting them out from under foot.

The presence of unexplained sones of varying sizes, of broken pots and pieces of deer bone as well as deer antlers in the roof debris in ancient pit houses, well above the floor level, has led to varying solutions of these oddities.

At times it has been suggested that the abandoned pits were used as trash or refuse pits when the site was reoccupied or even during the same period of occupancy. However, the paucity of such debris and the irregularity of the deposit often precludes the acceptance of this explanation.

Again these little questions were answered in a simple manner by the Sonoran examples. Some of the houses were not heavily covered with earth along the ridge of the roof and the brush protruded through the thin layer. On such houses, stones were used to hold the brush down.

PLATE 39

Beef bones, sheep bones and other cast-off remnants of food were likewise to be seen on the roofs whither they had been carelessly tossed by the inhabitants. On one roof lay a pair of grey, weathered, deer antlers, the souvenir of some ramble through the hills. On another lay some fragments of unpainted, modern Papago pottery.

It is easy to postulate the fate of these articles when those pit houses sink into the earth, and in this postulation one may inversely raise from the dead past the ghostly roofs of huts abandoned centuries ago with their accompanying litter of stones, pottery, bones and ashes.

It is a well-known fact that man is an animal fully endowed with the collecting instinct. Our Sonoran pit dwellers were no exceptions.

Somewhere in the region was an ancient village site. The inhabitants of the roadside camp had found this site and from it they had obtained old *manos* and two or three broken, battered stone axes. These tools had been carted into the village, used again and when the collection of huts was abandoned, the old implements were cast aside or dropped casually into the deserted pit dwellings. So with the broken pottery vessels obtained from the Papago Indians of the southern Papagueria (the Papago town of Quito Vac was but a few miles west of this village).

Summary

Whereas the author realizes that all problems of all types of pit house and surface structures encountered in the Southwest will not be answered in this description of a modern pit house village, nevertheless from the evidence presented in these descendants of ancient prototypes, certain hypothetical reconstructions may be rendered more valid by these descriptions.

PLATE 40

The discovery "in the flesh" of the many little puzzling features such as the absence of post holes in pit house floors, the absence of, or the rudimentary presence of entrance ways, the form and height of the roof structures, the method of construction, as well as the clear picture presented by the various phases of this abandoned camp, all tend to pave the way for a more logical explanation of similar features which may be discovered in the future upon more ancient camp sites.

Again, it is interesting to note that these pit dwellings and surface structures occupied the same camp at the same time. This is likewise a feature of some of the oldest sites. Furthermore, the use of the pit dwellings as winter habitations, their use mainly as sleeping quarters and the presence of small, open sun shades are likewise characteristic of the old sites, and the modern Indian villages as well, with this exception: true pit dwellings are seldom found on the reservations of today.

However, the winter hogan and the several types of airy summer hogans of the Navajo are modern parallels of the old dwellings. The Pima and Papago also have their summer and winter residences side by side, and in the summer work, eat and sleep under their sun shades, retreating into their wattle-and-daub or more modern adobe or frame houses only when it storms or the weather is otherwise inclement.

Furthermore, it is worthy of note that the builders of the modern pit village are nominally of Indian blood, recruited from various portions of Mexico, and although under normal conditions they do not live in these habitations of their ancestors, yet, as in the present instance, when forced to do so, have drawn upon the heritage of their ancestral culture and produced, upon the same ground, in the same primitive manner, exact counterparts of habitations which were once habitually used by their forefathers.

Thus it would seem that cultural germs once planted in the blood of a people and nourished only by traditions and sporadic transplanting will, in times of necessity, erupt and come forth full grown as the physical realities and then, the need having passed, lapse again into subconscious void of all human experiences.

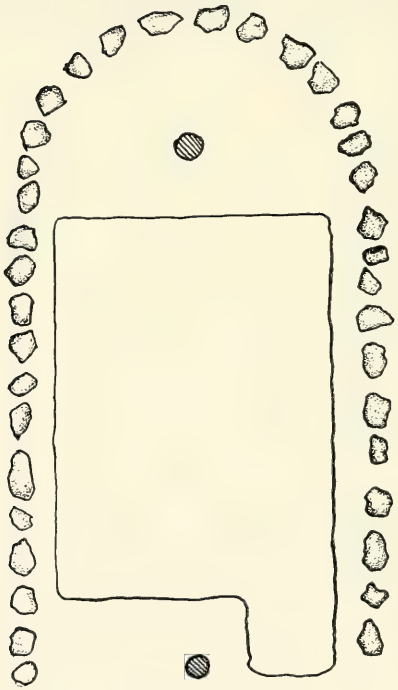

PLATE 41

SURFACE STRUCTURES

No.	Hse.	L.	W.	L. U.	D. U.	L. R.	D. R.	L. S.	D. S.
1.	Surf.	5' 10"	7' 6"	4' 9"	4½-5"	7' 6"	4-5"	6' 6"	1¾-5"
2.	Surf.	8' 6"	6'	3' 6"	3"	7' 6"	2½"	4' 2"	1½-2"
10.	Surf.	8'	8'	3' 7"	3-4"	8'	2½"	3'	2-2½"
11.	Surf.	7'	8'	4'	3½"	6' 6"	4"	6'	1½-2"
9.	(See remarks on construction.)								

PIT STRUCTURES

No.	Hse.	L.	W.	D.	L. U.	D. U.	L. R.	D. R.	L. S.	D. S.
3.	Pit	7'	5'	9"	4½'	3"	6½'	3"	5½'	1-1¾"
4.	Pit	5½'	2' 1"	1½'	3' 2"	1-3"	8'	2½"	2' 8"	2"
5.	Pit	5½'	3'	9"	2' 6"	3-6"	5½'	4"	3'	1-2½"
6.	Pit	4' 10"	2' 4"	22"	30"	2"	5' 4"	2"	3'	2"
8.	Pit	8'	2'	18"	35" *					
12.	Pit	5½'	4'	17"	34"	2½'	9'	3½-4"	4½'	1½-2"
13.	Pit	7½'	3'	18"	30" *					
14.	Pit	6-11"	6½'	20"	46-49"	3-3½' *				
7.	(No measurements taken; observed for door construction.)									

LEGEND: Hse.—House; L.—Length; W.—Width; L. U.—Length of upright; D. U.—Diameter of upright.; L. R.—Length ridge pole; D. R.—Diameter ridge pole; L. S.—Length side pole; D. S.—Diameter side pole.

MATERIALS USED

Uprights: *Palo verde.*

Ridge poles: *Palo verde.*

Side poles: *Palo verde*, mesquite and *ocotillo.*

Roofing: *Larrea mexicana* (creosote bush) lashed to cross rods of *ocotillo* on side poles and either covered with mud or left without earthen plaster.

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* See remarks on construction.

REMARKS

Surface structure No. 9 was different than the other surface houses. It was built of four arches of *ocotillo* stalks to form a light framework over which canvas or other cloth coverings had been placed.

Pit house No. 5 had a side entrance, however the door was not centered as will be observed in the photograph (Pl. 36). The peak of the roof was not plastered with mud. Rocks laid on the brush peeping out at the crest of the roof held the creosote covering in place. A brush mattress for a bed was found in this house. The door was 15 inches wide and 28 inches high. The corners of the pit were rounded.

Pit house No. 7 was noted chiefly for the triangular door depicted in Pl. 37. This door covering was constructed of *ocotillo* stems and brush roughly wattled, the outer frame being a single piece bent sharply in the middle and held in position by a bottom rod lashed to the lower extremities. This door was 2½ feet wide at the base, 2 feet high and the sides were each 2½ feet long.

Pit house No. 8 varied in that it had no uprights or side walls. This type dwelling was one of the simplest of pit houses. It was merely a shallow, sloping pit and had apparently served as a narrow subterranean sleeping room for one man. The roof was simply constructed. *Palo verde* rafters 2½-3 inches in diameter were laid transversely over the trench and upon these were laid brush and earth. The pit was 35 inches in depth at the deepest end, sloping to 18 inches at the opening. To enter this abode, the occupant needs must slide in on his stomach. A small, broken pottery bowl was found on the floor of this house.

Pit house No. 13 somewhat resembled house No. 8 in that this dwelling was likewise without uprights or side walls. However, the construction varied a bit in principle. Two large *sahuaro* trunks had been felled and these lay parallel, one on either side of the pit. The *palo verde* rafters were placed on these and the usual covering of brush and earth laid upon the cross timbers. This pit dwelling had a brush door, 30 inches wide. It was square and rested over the opening something in the manner of the familiar cellar door. In fact this dwelling somewhat resembled the "cyclone cellars" used in the middle western part of the United States. Upon this house lay the grey, weathered pair of deer antlers described in the text.

Pit house No. 12 had a step. This house is depicted in Pl. 33.

Surface structure No. 10 was practically square; the sides were of brush lashed to cross rods of *ocotillo*. A row of stones outlined the floor and earth was banked over these stones and against the base of the brush covering the sides of the dwelling. There were three uprights on either side which were shorter than the center upright. This provided a slight peak for the roof which was made of the usual *ocotillo* cross rods, brush and earth. In this house was a fireplace against the east side of the house, 4 feet from the door. There was no smoke hole; the smoke escaped through the loose brush sides of the dwelling.

Pit house No. 14 depicted in Pl. 35 was probably the most elaborately constructed pit dwelling in the encampment. The pit had straight, well-made sides. The row of stones on one side of the pit rested 6 to 7 inches from the edge of the excavation. Upon this row of stones the long side poles rested. A similar row of stones encircled the entire house but only on one side did the butt ends of the side poles rest. The remaining rocks served as a nucleus for the earth banking the sides of the dwelling.

NOTES ON THE LIFE HISTORIES OF TWO ARIZONA BUTTERFLIES

By John A. Comstock, Grace H. and John L. Sperry

During May of this year the authors collected a number of larvae belonging to two species of Melitaea, which were feeding on paint brush (*Castilleia lanata* Gray).

These were secured in a region known as Peppersauce Canyon, situated in the foothills of Lemmon Mountain, near Oracle, Arizona.

A series of these larvae were bred to maturity resulting in the following notes:

Melitaea theona f. bollii Edw.

Mature Larva. Length, 25 to 28 mm.

Head bilobed, bright yellow brown or orange, with a sparse covering of single long black hairs. Ocelli black on a black base which is slightly protruded. Mouth parts black, the clypeus flesh colored in its center. Basal segment of antenna flesh colored, with the tip black.

First segment fleshy yellow, crowned dorsally with a series of black nodules bearing black hairs which curve forward. Lateral to this crest are three small black points, and inferior to the latter are two black spines.

The body bears the usual series of branching spines which are characteristic of the genus. These are all glistening jet black.

The body color of the upper half of the larva is a velvety brownish black with a purplish cast.

Sprinkled over the surface of this area are numerous lens-shaped pearly white dots. These are, however, missing in the mid-dorsal area, which gives the appearance of a black mid-dorsal line, edged with a concentration of the white dots aforementioned.

The segmental junctures are purplish and shining, in contrast to the velvety texture of the segments.

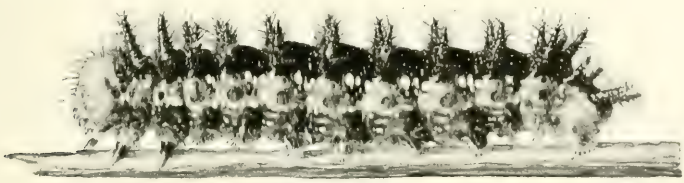

PLATE 42

Lateral view of larva of *Melitaea theona bollii*, enlarged x 3.

Photo by Menke

A broad stigmatal fleshy-yellow band runs longitudinally the full length of the larva. The stigmata, which are black, stand out in strong contrast on this band, as do also the black substigmatal spines. This yellow band extends inferiorly as far as (and including) the overlap, and it also runs caudally on to the anal proleg, and surrounds the anal orifice.

Between each of the spines of the lateral row there are two or three large white dots, the largest about .5 mm. in diameter. These are missing on the first two and last two segments.

True legs, glistening black. Prolegs reddish brown, with a jet black plate placed laterally on each, and with black claspers. Anal proleg concolorous on its lower aspect with abdomen, the latter being a rosy brown. The surface of the abdomen is covered with numerous small soiled white dots, and a sparse sprinkling of light hairs.

One larva measuring 3.5 mm. in length and probably in the second instar, showed a ground color of soiled yellow. The spines were black, with brown at their bases. The mid-dorsal row of spines was placed on a soiled yellow band, due to the fact that in this area the ground color was not spotted over with brown, as was the remaining surface.

Legs, black. Prolegs and anal prolegs concolorous with body. Stigmata black.

The head was black, with a sparse covering of brown hairs. Ocelli and mouth parts, black.

Another larva of 13 mm., probably in the fourth instar, showed markings and coloration similar to the mature stage except for the following points:

The body was somewhat darker, due to the reduction in relative size of the small white dots. The stigmatal orange band was absent except for a brownish shading about the spiracles.

Many larvae went into hibernation at the end of the fourth instar. In this state they take on a considerably altered appearance. The body assumes a brown shade, and the larva is shortened and plump, measuring about 10 mm. in length. The head turns to a yellow-brown and the stigmatal band becomes concolorous with the head.

Pupation, in a state of nature, probably occurs under rocks or on dry sticks at some distance from the foodplant. The usual button of silk is woven for cremasteric attachment.

The mature larva is illustrated on Plate 42.

Pupa. Length 12 to 14.5 mm. Greatest breadth through abdomen, 4.5 to 5 mm.

The pupa is of characteristic Melitaeid form, though somewhat more cylindrical and elongate than the average. Ground color, velvety white.

In the mid-dorsal line there is a row of black dots over the abdominal area only, one to each segment. Lateral to this line

of dots is a wide black line extending from the front of the thorax to the segment immediately in front of the caudal where it usually ends across the dorsum by fusion with the equivalent band of the opposite side. This wide longitudinal band is interrupted at each segmental juncture by an orange quadrate spot, the latter placed anterior to the juncture.

Lateral to the line just described there is, on the side of the thorax at the upper edge of the wing case, an irregular black line with a single orange spot dividing its anterior $\frac{1}{3}$, from its posterior $\frac{2}{3}$. This line ends posteriorly as a harpoon-like point. On the abdomen, in line posteriorly with the above-described band, is another series of round dots, one to a segment, each of which is above and slightly anterior to the spiracle.

A third black longitudinal band begins near the shoulder and arches across the wing case, bending upward as it terminates at the edge of the latter. Below this a fourth line begins on the wing case, runs diagonally upward and caudally, to be continued onto the abdomen as a sub-stigmatal band. The abdominal portion of this band is interrupted near the segmental junctures, as was the dorso-lateral band, by quadrate orange spots.

On the ventral surface there is, in the median line, a broad black band of peculiarly irregular shape, beginning near the facial segments and extending onto the cremaster. This is well brought out in the illustration. See Plate 43. Orange spots interrupt this band only on the abdominal segments.

A few additional black spots and bars are present which are shown in the illustration.

One specimen, which pupated May 19, emerged on May 28. The pupal duration is probably 8 to 10 days, on the average.

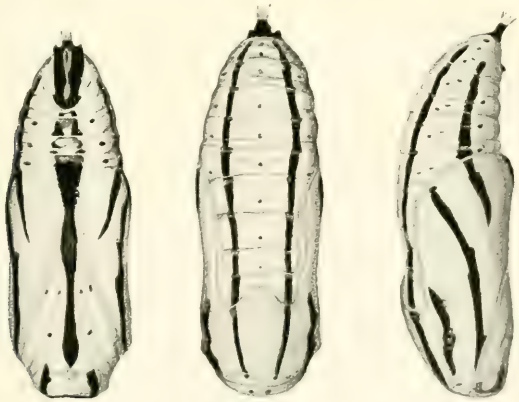

PLATE 43

Pupa of *Mel. theona bollii*, ventral, dorsal and lateral aspects, enlarged x 4.

Drawing by John L. Sperry

MELITAEA FULVIA Edw.

This species is apparently common in Arizona where *Castilleia* occurs, and ranges eastward to southern Colorado and Texas. It is somewhat variable and examples occur in which the color and pattern closely approximates *alma*. There is one point, however, on which the species can be at once separated. In *M. alma* the palpi are always a deep orange, whereas with *M. fulvia* they are black above and white beneath.

The larvae clearly show the species to be distinct.

Oviposition evidently occurs at the base of the plant en masse as the newly emerged larvae are always found in a web at that locus.

Larva, first instar. Description made from an example measuring 3 mm.

Head black, with short black hairs; mouth parts black.

Body yellowish with the tops of the segments a glistening pearly yellowish white.

There is a suggestion of a longitudinal dorso-lateral light orange line.

The first segment bears a scutellum of black with a series of long black hairs arching anteriorly.

The body carries the usual rows of long simple hairs. These are black, and each one arises from a black papillus. The caudal segment also bears a black tubercle clothed with black hairs.

Legs, grayish black. Prolegs and anal prolegs concolorous with body, with the terminal segments and claspers darker.

2nd instar, 24 hours after moult. Length 5 mm. Body color, gray-green, sprinkled with brown.

There is a slight concentration of brown in the median dorsal area suggesting a mid-dorsal line. A similar suggestion of a line occurs in the region of the dorso-lateral spines.

The brown pigmentation is absent in the region of the stigmata which leaves a wide band of olive.

The entire abdominal half of the larva is thickly sprinkled with brown.

Head, jet black, with a covering of short black hairs. True legs, black. Prolegs and anal prolegs gray-olive, with black patches on the outer surfaces of the coxae.

Stigmata, gray-black.

The branching spines characteristic of the mature larva are present, though somewhat reduced in relative size. The shafts of these spines are gray, becoming nearly black at the tips, while the accessory branches are jet black.

3rd instar, 24 hours after moulting. Length 6.5 mm.

Body now jet black, as are all spines.

Head, *rich brown*, with black hairs. The coloration is that of the mature larva from this stage on.

Mature larva. Length, average 25 mm.

Head, rich orange-brown. Mouth parts black, except the clypeus which has a soiled yellow center, and the proximal segment of the antenna which is yellow.

Ocelli, black on a raised black field.

The first segment is bright yellow except for a prominent scutellum of black with numerous long and short black hairs, and two lateral black branching spines.

The usual number of branching spines are present such as are characteristic of the genus. These are a glistening black throughout.

PLATE 44
Mature larva of *Melitaea fulvia*, enlarged x 2.
Photo by Menke

Ground color of body, rich velvety black. On each side of the median line is a longitudinal row of bright yellow spots, arranged as shown on the illustration, Plate 44. These are grouped in threes on each side of the median line, except in the case of the second segment, where there are usually four. Another series of similar spots, irregular in shape, are placed stigmatally, giving the appearance of a wide broken yellow stigmatal band.

Stigmata, black, surrounded by a yellow circlet. Legs, jet black. Prolegs concolorous with abdomen, which is a gray black or brownish shade. The coxae, however, are black as are also the claspers. On the lateral surface of the anal proleg there is a shining black patch. One specimen which was carried through from the first instar to maturity moulted on the following schedule:

1st moult	(2nd instar)	May	20.
2nd "	(3rd ")	"	24.
3rd "	(4th ")	"	27.
4th "	(5th ")	June	1.
Pupated	- - - - -	"	8.
Emerged	- - - - -	"	17.

A second specimen which pupated May 20, emerged May 29.

It will be noted from the above that in the last three instars this larva has an orange head. This feature serves to differentiate it from the larvae of the *wrighti-alma* group.

Pupa. Length, 12-14 mm.

The color and shape of the chrysalis so nearly approximates that of *Melitaea wrighti,* as to render a description unnecessary. It is illustrated on Plate 45.

Larvae were found on *Castilleia lanata* Gray but in captivity readily accepted other species of the genus.

PLATE 45

Pupa of *Mel. fulvia* enlarged x 4.

Photo by Menke

EARLY STAGES OF THREE CALIFORNIA DIURNALS (Lepidoptera)

By John A. Comstock and Charles M. Dammers

Strymon saepium Bdv.

Larvae of this species were beaten from *Ceanothus cuneatus* Nutt. on June 17, 1933 in Bouquet Canyon, and were bred to maturity. Eggs had previously been secured in June of 1930 from the same locality, but failed to hatch.

Egg. Echinoid; .8 mm. in diameter x .4 mm. high. Color, a delicate gray-green of such a light shade as to appear almost white. Micropyle deeply depressed and surrounded by a slightly raised ring.

The surface is covered by a fine reticulation of raised walls, outlining deep pits of an irregular hexagonal type. From the junctures of these walls arise pointed spicules, which give the egg an encrusted or frosted appearance.

The illustration, Plate 46, serves to bring out these details more perfectly than can be suggested by a description.

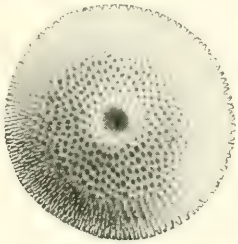

PLATE 46
Egg of *Strymon saepium*, viewed from the top. Magnified x 40.

The female deposits her eggs singly, on the stems of the foodplant. These, when laid by the last brood, undoubtedly over-winter as ova.

Described from four eggs deposited June 21, 1930. Undoubtedly the species feeds on many different species of *Ceanothus*.

On two separate occasions the junior author carried eggs of *S. saepium* through the winter from which young larvae hatched in the following spring, but failed to reach maturity.

Mature larva. Length, average 16 mm.

Body color, leaf green, of the same shade as the foodplant. There is a slight indistinct line on each side of the mid-dorsal area and a similar but more conspicuous line runs longitudinally along the overlap. Connecting these lines are a number of barely suggested diagonal lines of light greenish yellow. These begin on the

subdorsal line and run diagonally downward and backward but do not quite join the sub-stigmatal line.

Stigmata light green and barely distinguishable. Legs green, with brownish tips. Prolegs concolorous, with body. Cervical shield depressed and covered with minute spicules.

Body completely covered with short stout vibrissae. The majority of these are frosted white, and turn over so as to lie flat along the body surface. Interspersed between these are a few shorter spicules of a light brown color, standing upright. On the first and second segments the short brown spicules predominate, and there are also a few long curling hairs on the outer margin of the first segment.

Head brown, shading to black on the outer margin. Glabella edged with white. Ocelli, black. Antennae white, shading to brown on the tips.

This larva is of the usual slug type (see Plate 47) with retractile head and a cowl-like first segment which is slightly retractile into the second. It is thickest dorso-laterally at about the seventh segment, and slopes posteriorly to a decidedly flattened anal end.

PLATE 47

Larva of *Strymon saepium*, dorsal aspect, enlarged x 4.

Photo by Menke

Pupation usually occurs on a leaf of the foodplant, the chrysalis being suspended by means of a delicate girdle and cremasteric button.

Pupa. Length 10 mm. Greatest width 4 mm. The color is at first a uniform green, changing in about six hours to a wood brown, with a profuse sprinkling of black, particularly on the wing cases.

The surface is covered with clubbed hairs, except on the wing cases, over the shoulders and facial portions. These hairs are light brown in color, and vary in length. Those over the anterior thoracic region and along the lateral surface of the abdomen are longest.

Spiracles, small, inconspicuous and concolorous with body except for the first, which is prominent, slightly protruded and a light brown.

Abdomen strongly arched ventrally.

One example which pupated June 22 emerged July 3. The pupa is illustrated on Plate 48.

PLATE 48

Pupa of *Strymon saepium*, ventral, lateral and dorsal aspects, enlarged x 4½.

Photo by Menke

STRYMON AVALONA Wright.

Through the courtesy of Mr. Charles Ingham of the Lorquin Entomological Society we received, on March 11, 1933, a number of examples of eggs and larvae of this species, collected by him on Catalina Island.

Several of these were bred to maturity, resulting in the following notes:

Egg: Of the usual echinoid form, with a large and deeply depressed micropyle and the characteristic reticulated network of raised walls enclosing cells of an irregular hexagonal type. Spiny projections are given off from the wall junctures, as with other nearly related species. Color, gray green with a blue cast. The eggs are deposited on *Lotus*, the plant of choice being *Lotus argophyllus* var. *ornithopus* (Greene) Ottley. They are laid singly, usually in the terminal buds or on immature blossoms.

Larvae were raised on *Lotus scaparius* Ottley. Probably they will accept any species of *Lotus*.

Plate 49 shows an egg, partly buried in the hirsute terminal bud of *L. ornithopus*.

PLATE 49

Egg of *Strymon avalona*, partly obscured by hairs on the terminal bud of *L. ornithopus*. Magnified x 40.

Photo by Menke

Larva, first instar.

The body is a pale yellow-green. Across the center of each segment there is a band of brown specks, interrupted dorsally and laterally thus giving the appearance, when the insect is not extended, of longitudinal yellow-green bands.

There are the usual eight rows of colorless hairs arranged longitudinally, one to a segment, as shown on Plate 50, fig. A. The first, second and caudal segments are speckled with brown.

Legs, colorless. Prolegs, pale greenish brown. Spiracles invisible. Overlap, greenish brown.

Head, buff, with darker mouth parts. Ocelli, dark brown.

In successive instars there is considerable variation in the color, ranging from a red brown through gradations to a greenish red. The lighter form will be here described.

Ground color, greenish yellow, with the raised portions red-brown. There is a mid-dorsal soiled white line. Across each segment there is a soiled white diagonal bar, placed laterally, also, in close association with the termination of each one of these bars is a horizontal dash, placed supra-stigmatally.

The overlap or infrastigmatal fold is a soiled white.

Spiracles brown. Legs, pale yellow-green; prolegs of the same color. The abdomen is concolorous with the body .

Head, buff and translucent; mouth parts and ocelli brown.

The entire body is covered sparingly with short white hairs arising from brown punctae. Plate 50, fig. B shows a larva in its third instar.

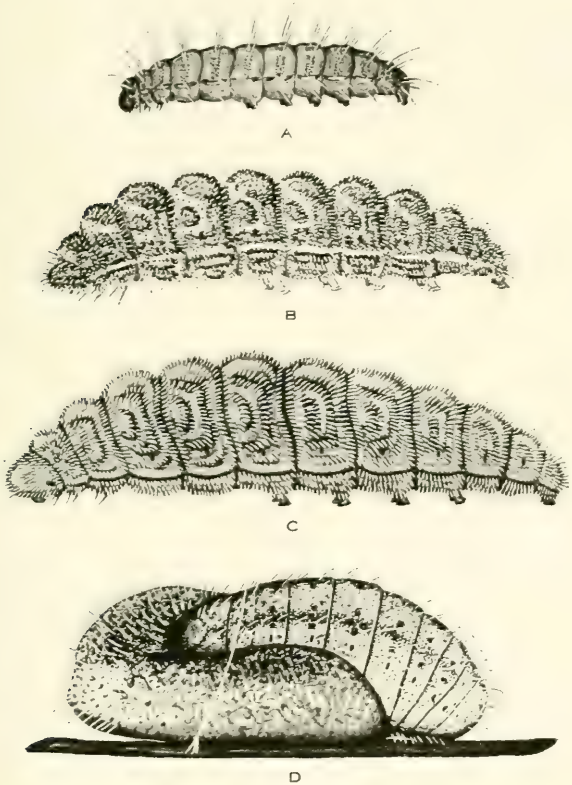

PLATE 50

Larva and pupa of *Strymon avalona*.

A. Larva, first instar, enlarged.
B. Larva, third instar, enlarged.
C. Mature larva, enlarged x 5.
D. Pupa, lateral view, enlarged x 6.

Drawing by Dammers

Mature larva. Length, 13-15 mm.

The same variation in color, as recorded for the intermediate stages, characterizes the mature larva. The range is from a pale apple green to a pale pink.

The pale form may be described as follows:

Ground color of body, pale apple-green, with no special markings or shadings; except on the cervical shield.

Spiracles, pale brown. Legs, pale green with light brown points. Prolegs also pale green, with light brown claspers.

The cervical shield has a pale green band down its center, and the upper half is speckled with black.

The entire body of the larva, except the cervical shield, is covered with short white pile.

Head, pale olive green. Ocelli, green on a black patch. Mouth parts pink.

Plate 50, fig. C shows a lateral view of the darker type of larva.

Pupa. Length 9 mm. Greatest width through mid-abdominal region, 4.2 mm.

The body is a pale pinkish-brown or wood brown, shading to buff on the abdomen. There is a mid-dorsal and lateral band of dark olive speckling.

Two rows of dark olive spots occur above the spiracles. The remainder of the body is sparingly speckled with olive. Spiracles, olive.

Thorax, soiled white with a pinkish cast, and heavily mottled laterally with dark olive. The head is concolorous with the thorax, and is sparingly covered with dark olive speckling.

Wing cases heavily irrorated, and a pale olive-white, blotched with dark olive.

The head, thorax and body are covered with pale yellow pile.

Pupation occurs at the base of the foodplant, with the usual support of a delicate silk girdle.

Imagos emerged from the 9th to the 18th of May. Undoubtedly the insect is multiple brooded. Thus far it has been reported only from Catalina Island.

THORYBES MEXICANUS Herrich-Schaeffer.

This moderately sized species occurs sparingly in our southern mountain ranges. It has been dealt with under the above name by a number of writers, including Dr. Holland in his latest edition of the "Butterfly Book."

We are aware that Bell treats our California form under the name of *Thorybes diversus,* but are, for the present, using the cognomen which is more familiar to our local entomologists.

Our opportunity to study the life history of this species was made possible through the keen observation of Mrs. Dammers. It was she who first detected a female in the act of ovipositing on *Amorpha californica.*

Egg. 1.3 mm. in diameter by the same in height. Color, a glistening white. The shape is spherical, with a slightly flattened base.

The surface of the egg is crossed longitudinally by about 13 sharp ridges, beginning near the base and running toward the micropylar area, where each ridge fades out. None of these ridges join or become confluent with others. The depressions between these ridges are crossed horizontally by poorly defined secondary ridges, as is clearly brought out in the illustration, Plate 51.

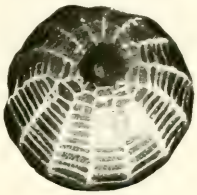

PLATE 51

Egg of *Thorybes mexicana*, magnified x 18.

Drawing by Comstock

The micropylar area is slightly flattened and somewhat pitted, and the central portion is slightly depressed.

The female deposits her eggs singly on the foodplant, *Amorpha californica* Nutt. The example from which our drawing was made was laid June 14, 1932. Others, secured from captive females on the same date, hatched June 24, and on.

Larva, first instar.

Head black, and exceptionally large in proportion to the body. Body, yellow-green, except the first segment which is black. All legs are pale green.

Successive instars.

Head black, covered with colorless pile. Body greenish yellow, irregularly speckled with white, and covered with colorless pile. The first segment is bare, and ivory white except for a black scutellum immediately back of the head and a black collar. Abdomen and all legs concolorous with body.

Spiracles, white.

Mature larva.

Length 30 mm. The shape is of the usual Hesperid type, but with a disproportionately large head, and less constricted neck than with most others of the group.

Head, dark maroon, profusely covered with fine buff pile.

The first segment continues to show the black collar and prominent black scutellum. The remainder of the body is buff-orange, heavily blotched with maroon, and covered with raised buff punctae from each of which arises a single short colorless hair. A thin mid-dorsal maroon line extends from the second to the tenth segments. There is also a narrow lateral line running longitudinally from the third to the tenth segments. The infra-stigmatal fold is pale maroon.

Abdomen, concolorous with body though of a somewhat lighter shade, and with a tinge of pink between the legs.

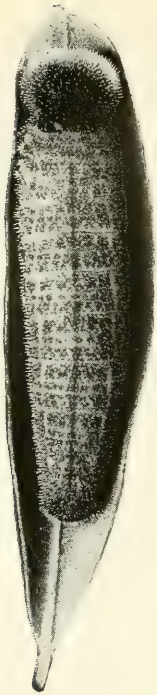

PLATE 52

Larva of *Thorybes mexicana*, on leaf of *Amorpha*, enlarged x 2.

Photo by Menke

Legs, first pair black; the remainder concolorous with body, with pale brown points. Prolegs and anal prolegs, concolorous with body, the claspers gray. The mature caterpillar is illustrated on Plate 52.

The larva pass their entire life, when not feeding, concealed in silken nests formed by uniting several leaves. They ceased feeding early in September and after shrinking noticeably went into hibernation but did not pupate. They were examined on March 14, 1933, and fresh foodplant placed in the breeding cage. On March 16 two had pupated. The remaining examples refused food although it was placed with them daily, and by July all had died.

Pupation took place in the hibernaculum.

Pupa.

Length, 17 mm. Greatest width through abdomen, 5.5 mm. Color, blackish-brown over the head, anterior thorax and last caudal segments, shading to a dull buff over the wing cases. The thoracic portion shows an undertone of dark olive over which is superimposed a mottling of black, with numerous black punctae.

The abdominal segments are heavily shaded with black on their posterior margins, and light tan to brown on their anterior margins, with a sprinkling of black dots. Cremaster, black, stout, recurved ventrally, and bearing small hooks at its tip.

Spiracles, narrow, dark brown, except the first which is jet black, large, and protruding.

The face, dorsum and abdomen are sparsely covered with short yellow-brown pile. Plate 53 shows the pupa in sufficient detail to make further description unnecessary.

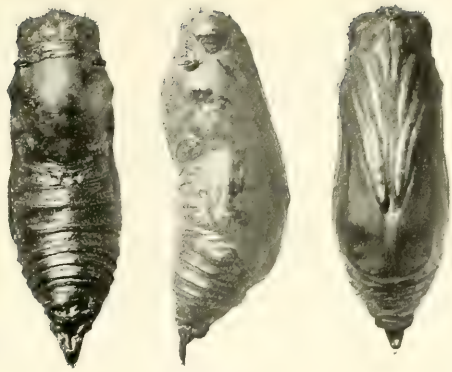

PLATE 53

Pupa of *Thorybes mexicana*, dorsal, lateral and ventral aspects. Enlarged x 2½.

Photo by Menke

STUDIES IN PACIFIC COAST LEPIDOPTERA

(CONTINUED)

By John A. Comstock

Basilarchia weidemeyrii nevadae B. & Benj.

This subspecies is well established at Mono Lake, California, where a large number of specimens were secured this year. Comparing these with paratypes of *nevadae* B. & Benj. discloses a slight tendency toward wider white fascial bands on primaries and secondaries, and, in general, a somewhat more prominent white dash in the cell of the primaries, but as these features are variable it is deemed inadvisable to create a separate racial name for the California examples.

Basilarchia lorquini also flies in this locality, and it is probable that hybridization has frequently occurred, which is believed to account for the fact that a certain percentage of the Mono Lake captures show traces of the apical brownish red coloration in the primaries.

While this form is not constant as regards the degree of this coloring, and ranges all the way from a mere trace, to such an amount as almost to suggest *lorquini,* there is nevertheless one constant feature which separates them from true *lorquini.*

This is the absence, on the under surface, of the usual red-brown suffusion of the secondaries. They are, in fact, typical *nevadae,* with the addition of the *lorquini* patch on the apices of forewings.

This form was given the name of *fridayi* by Gunder.

One egg, and a number of larvae of *B. nevadae,* were secured on willow and are now under observation. As previously pointed out by Edwards (Can. Ent. Vol. XXIV, p. 107), the early stages of *weidemeyrii* are very similar to those of *disippus,* as regards color, form and habits. The same holds for the larvae of the race *nevadae.* The one egg which we observed was slightly more conical than the egg of *B. obsoleta,* but was similar in all other particulars.

The larvae went into hibernation in their third or fourth instars, after producing the usual type of hibernaculum.

A large colony of *Satyrium fuliginosa* Edw. was found this summer near the Virginia Lakes, Mono County, on July 28. They were limited to a small area of about an acre in extent. Observations were made on the laying habits of the females, resulting in the ensuing notes:

The foodplant is *Lupinus.* The female alights on the lupine leaf, and leisurely makes her way down the stalk to the base of the plant. She then proceeds to poke her abdomen deep into the detritus about the base of the stalk, and after many trials deposits the egg.

Mrs. Comstock and I searched diligently and fruitlessly many times without being able to locate the egg among the sticks and small pebbles in which it was deposited. We did succeed, however, in expressing three eggs from laying females.

The egg is, at first a gray green, changing later to ivory-green. It is very different from the egg of most Lycaenidae. In form it is a plump echinoid with a moderately depressed micropyle. The surface is finely granular, but there are no ridges, reticulations, spines or prominences of any nature.

STRYMON CALIFORNICA Edw.

On June 10, 1933, while beating for larvae at Lebec, a single caterpillar of one of the Lycaenids was secured from *Quercus,* which was successfully bred to maturity and proved to be *Strymon californica* Edw.

Since the early stages of this species are unknown, the following notes may be of help to entomologists as a starting point for the eventual complete description of its metamorphosis.

Mature larva. Length 12 mm. This specimen was somewhat dwarfed and the normal larva is probably considerably larger.

Slug-shaped; general coloration, gray-brown. The body is relatively uniform in width except for the tapering caudal segments and the first thoracic.

Head, ocelli and mouth parts, jet black, except for the edge of the glabella and the proximal joints of antennae, which are ivory white. The head is retractile and is seldom extended beyond the fleshy cowl even during the act of feeding.

PLATE 54

Larva of *Strymon californica*, enlarged x 4.

Photo by Menke

The cervical shield is grayish-black, mottled, and is free of pile. A narrow gray-white line bisects it longitudinally, and there are a number of minute black nodules scattered over its lower half.

The first segment is fleshy, and is black above and dirty gray beneath. Over its surface are scattered numerous black tubercles, each one of which bears a single hair. The upper series of these hairs is black or gray, while the lower hairs are white.

In the mid-dorsal area there is a longitudinal row of subovate gray large spots, one to a segment, each of which is connected with its fellow anteriorly and posteriorly. The surface of this area is sparsely covered with minute black papillae, some of which carry minute spiculiferous hairs.

Lateral to each one of these large spots is a narrow soiled white line, which fades out as the middle of the segment is reached, and which is widest at the anterior edge of the segment.

Over this line there are scattered series of prominent black papillae, each one of which bears a long black hair.

The area lateral to these hairs is brown (lighter brown on the segmental junctures) as far down as the overlap. This brown area is sparsely covered with minute papillae similar to those occurring over the mid-dorsal area.

There is a gray indistinct area above each spiracle, edged above and below with dirty white dashes. These dashes or interrupted lines take a triangularly downward and backward course, and do not extend over the segmental junctures.

The edge of the overlap is marked by a narrow soiled white line (interrupted at the segmental junctures) and on this line there are numerous black papillae, topped by long black hairs. Below the substigmatal line is a purplish-brown area, interrupted on the segmental junctures with yellow-brown. Inferior to this the abdominal surface is gray-green or soiled ivory, and is thickly studded with black papillae, bearing white hairs.

Stigmata, gray-brown, with narrow dark brown rims.

True legs black. Prolegs concolorous with abdomen. Anal proleg, purplish brown above, ivory below.

Additional features not specifically described above may be noted on the illustration of the larva, Plate 54.

Pupation occurred on June 21, and the imago emerged July 2. The pupa attached itself to the upper surface of an oak leaf, and, as is shown in the illustration, Plate 55, was held in place by two girdles, and the cremasteric pad of silk. This double girdle probably represents an individual variation from the normal habit.

Pupa: Length, 7 mm. Greatest width, 3 mm. Ground color, red-brown over the thorax and abdomen; lighter brown over the cephalic portion, and ivory-green on venter and wing cases.

The entire surface is mottled with black spots, many of which are confluent. These are somewhat similar to the mottling on the chrysalis of *Callipsyche behrii,* though not as clearly defined. They do not show to advantage in the illustration.

The thorax and abdomen are sparsely covered with long simple colorless hairs.

Spiracles, dirty white.

Cremasteric hooks, numerous, short, yellow-brown.

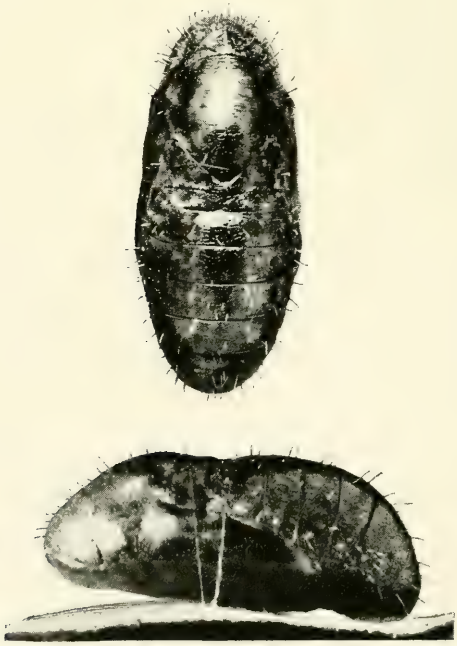

PLATE 55

Pupa of *Strymon californica.* Enlarged x 7. Upper figure, dorsal aspect. Lower figure, lateral aspect.

Photo by Menke

The form of this chrysalis is shown in the accompanying cut with sufficient accuracy to obviate the need of a more lengthy description.

LITOPROSOPIS COACHELLAE Hill.

In the summer of 1930 a large number of specimens of this heretofore rare moth were taken in the city of Los Angeles. Their occurrence in this vicinity had been noted and called to our attention by the late Dr. John Hornung in 1929, but the hatch in 1930 was phenomenal, and has not since been equaled.

The moths were found at night resting on the trunks and about the bases of the Washingtonia Fan-Palm, and were easily captured with the aid of a flash light and cyanide bottle.

Whether they were introduced in this territory from the Coachella Valley prior to 1929 has not been determined, but an examination of a number of collections made prior to that time fails to show any record of its earlier presence in Los Angeles County. It is now quite widely distributed throughout Southern California.

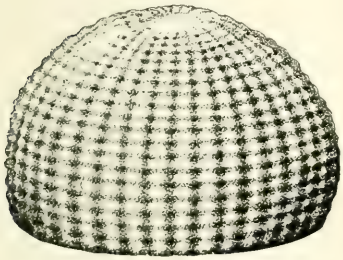

PLATE 56

Egg of *Litoprosopis coachellae*, magnified x 50.

Drawing by Comstock

The eggs are laid in clusters on the dry disintegrating fronds of the Palm, and are completely covered by a mat of filamentous hairs from the anal segments of the female. They are placed on the outer surface of the leaves, and somewhat resemble, superficially, the nest of a spider. Each cluster contains from 30 to 40 eggs.

Egg. Size, approximately .9 mm. at the base, and .7 mm. in height. The shape is a robust hemisphere with a flattened base, and the surface is covered by about 34 vertical ridges, radiating outwardly and downward from the micropyle. These ridges, and the depressions between them, are crossed by horizontal depressions, which give the egg a distinctly cross-hatched appearance. The color is a pale yellow-green when first laid, changing later to a soiled white. Micropyle only slightly depressed.

An illustration of the egg is shown on Plate 56.

Eggs laid September 13, 1930, emerged September 18.

Larva, first instar. Length: average 2.5 mm. to 3 mm.

Colorless, or translucent except for a slight shading of brown around the mouth parts. Ocella, black. Head larger than body,

the remaining segments tapering toward the narrow anal portion. A few sparse colorless hairs protrude from the head.

The head and body of the larvae are much flattened dorso-vertically. In other particulars they closely resemble the mature form.

The newly emerged larvae remain for a short time in a mass, feeding on the egg shells, under cover of the mat of maternal scales, and then scatter. They are, at this time, very active, and probably feed on disintegrating palm fronds, although the actual process of feeding was not observed.

Mature larva. Length — average about 37 mm.

Head, light straw in color; bare except for a few light hairs. Mouth parts mainly dark brown. The anterior 2 ocelli are dark brown, the remainder being lighter in color.

Body greatly compressed dorso ventrally, in adaptation to the larval habits, allowing freedom of movement in the narrow spaces between the bases of the palm stems.

The first thoracic segment is light straw, concolorous with the head, as is also the posterior half of the anal segment. The remaining segments are a pinkish brown, slightly mottled. There is a faint suggestion of a mid-dorsal narrow line.

A number of rows of single light colored hairs occur over the dorsum, disposed as shown on Plate 57. One of these is situated on each side of the mid-dorsal area; a second row occurs lateral to this, and a third is placed suprastigmatally. A fourth row of somewhat longer hairs occurs laterally below the stigmata, and a few additional minute hairs are found in relation to it.

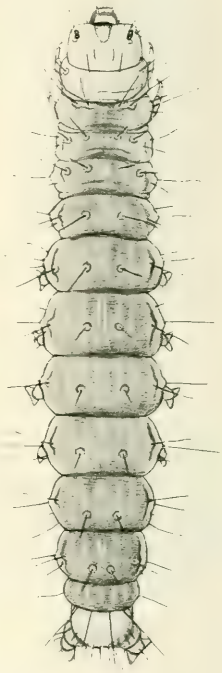

PLATE 57

Larva of *Litoprosopis coachellae*, dorsal view, enlarged x 2½.

Drawing by Comstock

All of the hairs arise from small papillae, which are for the most part of a lighter color than the surrounding area. The legs and prolegs protrude laterally and are thus visible from the dorsal aspect. They are of a light straw color.

The abdomen is concolorous with the legs.

Stigmata, yellow brown, rimmed with narrow brownish black edges.

One smaller larva measuring 22 mm. shows only a trace of the dorsal pinkish shade and has two supra-stigmatal pinkish lines,

the one nearest the stigmata being wider. It also bears a well defined pink mid-dorsal line. Another of 17 mm. length, probably in the third instar, shows the same marking.

The mature larvae frequent the reddish brown reticulated fibrous bases of the palm fronds, particularly those of the dead leaves.

This probably constitutes their food, if one may judge from the color of their frass, and the further fact that no portion of the palm shows any evidence of being eaten. Even the most heavily infested trees show no perforation of the green or dried leaves, or young shoots.

The trees which yield the greatest number of moths are invariably those of 20 to 25 years of age, from which the dead leaves hang in beard-like festoons. Trees from which the leaves have been trimmed show no infestation.

PLATE 58
Pupa of *Litoprosopis coachellae*, dorsal, lateral and ventral aspects, enlarged x 3.
Photo by Menke

Pupa. Length, average 21.5 mm. Greatest width through shoulders, 5.5 mm.

Color, straw, with a slight tinge of green over the thorax. There is a barely perceptible mid-dorsal stripe, dull green in color. The segmental lines are narrow, and dark brown, in strong contrast to the light body color.

Caudal end flattened, and with two short cremasteric hooks protruding, the latter brown-black.

Spiracles, dark brown.

The texture of the pupa is smooth, glistening and waxy. There are no vibrissae or protruding appendages other than the cremasteric hooks. It is illustrated on Plate 58.

Pupation occurs at the base of the Palm stems, in the brown "latticed" fiber. A cocoon is made which is surrounded by this material on three sides (see Plate 59) and by the stem of the Palm leaf on its outer aspect.

PLATE 59

Pupa of *Litoprosopis coachellae* shown in cocoon which has been opened.

Photo by Menke

NOTES ON SOUTHWESTERN CACTI

By Wright M. Pierce and F. R. Fosberg

The writers have spent considerable time during the last few years studying cacti in the field, in the herbarium and in the garden of the senior author. The following are some of the results of this observation. Specimens cited are in the Pomona College Herbarium.

Opuntia Bigelovii Engelmann var. Hoffmannii Fosberg n. var.

Caules ascendentes vel erectes, e basibus et prope apicibus ramosi, ramuli apicali horizontali; spinae breviores, aliquantum rubrae.

Plants up to 2.5 m. tall, often ascending rather than strictly erect, the dead lower lateral branches more promptly deciduous than in the species leaving the long cylindrical trunk conspicuously bare of branches excepting at the summit where there is a crown of short, mostly horizontal branches and at the base where the main trunk often branches. Branching also occurs rarely further up. Plants less densely armed than in the species, the spines a trifle shorter than in the species and having a pronounced roseate color, especially on the younger parts of the plants. Flowers not seen. Fruit as in the species excepting the long glochids or deciduous spines, which are decidedly reddish.

This plant was discovered on the alluvial fan at the mouth of Cane Brakes Canyon, at the east base of the Laguna Mountains in eastern San Diego County, California. It is abundant on the fans at the foot of the mountains from this locality for a distance of about five miles southeast. Throughout this area it grows side by side with the typical form of the species which here never reaches more than one meter in height and is densely armed with long shining ivory white spines. There was seemingly no intergradation whatever. Students who consider that any character that is constantly different, however minute, is sufficient foundation for a species would doubtless consider this plant specifically distinct. However, it is so evidently a recent offshoot from O. Bigelovii and the distinguishing characters are mainly vegetative and of such minor importance that I feel that its true relationship and degree of distinction is best shown by the varietal category. The height, the ascending trunks, bare of branches, and the crown of horizontal branches at the top give this plant almost the aspect of Opuntia fulgida.

I am naming this variety in honor of Mr. Ralph Hoffmann, late director of the Santa Barbara Museum of Natural History, student of cacti and succulents and botanical explorer of the Santa Barbara Islands, who so recently met with a fatal accident while

botanizing on San Miguel Island. The type is Fosberg No. 8602 from the mouth of Can Brakes Canyon. Fosberg No. 8601 is a specimen of the ordinary form of O. Bigelovii from the same locality. Both specimens are being placed in the Pomona College Herbarium. Several isotypes will be distributed to other institutions.

Opuntia prolifera Engelmann.

To Mr. Hoffmann's records establishing the northern and western limits of this species (Journ. Cact. Soc. Vol. IV, No. 3, p. 256, Sept. 1932) may be added another, Fosberg No. 8611, from the west slopes of the hills at the foot of the Conejo Grade, Ventura County, California. The plant is quite abundant and well developed here. Contrary to a commonly accepted opinion we observe that quite in accordance with Britton and Rose's description (Cactaceae I, p. 69) the terminal joints of this plant do break off easily. This has been observed at all of the stations where we have studied O. prolifera, in Lower California at several localities, Coronado Islands, San Diego, Santa Catalina Island, Laguna Beach, San Pedro Hills and the locality cited above.

Opuntia fulgida Engelmann.

Small plants were observed, first in Sonora and later in several localities in southern Arizona, which were taken to be Opuntia fragilis (Nutt.) Haw. far out of range. Careful study revealed these to be plants growing from joints and fruits and possibly some from seeds of Opuntia fulgida. They were particularly numerous in the immediate vicinity of plants of O. fulgida and were not found where none of the latter occurred. They also graded imperceptibly into the robust form of normal young plants of O. fulgida. This situation seems parallel to that of Opuntia tunicata (Lehm.) Link & Otto with its dwarf plants, described as Opuntia stapeliae DC. and discussed by Britton and Rose (Cactaceae I, p. 66).

The less spiny form of O. fulgida which Britton and Rose mention (Cactaceae I, p. 67) has a distribution which is not as general as that of the normal very spiny form. So far as we have observed, it does not occur where the normal form is absent, but neither does it always occur where the normal form is found. It seems particularly abundant in localities east and south of Tucson, Arizona. It intergrades perfectly with the normal form in armament and does not seem to vary much in any other character. This would practically preclude its being the result of hybridization of O. fulgida with O. versicolor as has been suggested by the fact that the latter is usually observed to be present in localities where the less spiny form occurs.

Opuntia acanthocarpa Engelmann.

The distinction of this species in California is not delineated

at all in Britton and Rose, being merely cited as "California" along with several other states: (Cactaceae I, p. 57). Parish restricts it to the eastern Mojave Desert (Jeps. Man. Fl. Pl. Calif., p. 655). We have observed O. acanthocarpa in the Palm Springs region in Palm Canyon and Deep Canyon, in Borrego Valley, San Felipe Valley, from here south through Mason Valley, Vallecito Valley and along the base of the Laguna Mountains to the mouth of Carrizo Creek and again on Mountain Springs Grade. Its range in eastern San Diego County seems in general higher than that of O. echinocarpa, which, so far as we have observed is absent from the series of valleys south of San Felipe. It is present, however, at the mouth of Carrizo Creek and on the lower part of Mountain Springs Grade. In upper San Felipe Canyon O. acanthocarpa seems to intergrade or hybridize with O. Parryi Engelm. specimens being observed which had spiny fruits but which had the aspect, otherwise, of O. Parryi. These two species can ordinarily be distinguished by the fact that in O. acanthocarpa the fruit, on the upper half is truly spiny and soon becomes dry, while in O. Parryi the areoles contain only glochids and the fruit remains fleshy for a considerable time, even when ripe. We would not consider the fruit of O. acanthocarpa strongly tuberculate. O. Parryi fruits are, contrary to Britton and Rose (loc. cit.), usually quite strongly tuberculate.

Opuntia ramosissima Engelmann.

Britton and Rose record this species as probably extending into northeastern Lower California (Cactaceae I, p. 46). This is confirmed by a collection made near Banded Agate Mountain in Baja California south of the Yuha Plain in Imperial County, California. The plants seen here and from which specimens were taken (Fosberg No. 8347) were low and diffuse.

Opuntia Chlorotica Engelmann.

This handsome Platyopuntia can be reported from southern San Diego County, California, where it was collected growing on the step rocky walls of the canyon below Buckman Springs in the chaparral belt (Fosberg Nos. 8603, 8638).

Echinocereus Engelmannii Parry var. Munzii (Parish) Pierce and Fosberg n. comb.

This plant was described as Cereus Munzii Parish (Bull. So. Cal. Acad., V. 25, p. 48, 1926). Parish remarked that this plant was related to Cereus mojavensis but that it had rose-red flowers. The only resemblance to the latter species which we have been able to note is in the habit, low and closely caespitose and in the curved character of the spines. It has the typical spine arrangement of E. Engelmannii with small radials and four heavy diver-

gent centrals. There is nothing to suggest the large, long radials and single central of E. mojavensis. This is a high altitude form probably parallel to the high altitude form of E. Fendleri mentioned in Britton and Rose (Cactaceae III, p. 36), much discussed, and in one case at least, named, by new species hunters of late. The flowers are like those of E. Engelmannii and vary from deep magenta-crimson to a pale yellowish pink, almost white. The only distinctive characters are those mentioned above, low compactly caespitose habit and long curving central spines. The habit character becomes very weak in the Hemet Valley collections (Munz & Johnston 5570 (type coll.)). A collection from 47 mi. s.e. of Tecate, Lower California, Mex. (Munz 9612) is characteristically this form in habit but has short straight spines which seem practically those of the species. The material from above Baldwin Lake on the desert slopes of the San Bernardino Mountains (Munz 5759) (Fosberg & Pierce No. 8552) seems to represent the extreme development of this form. The plants are very low, densely spiny with long curved spines. Here the range touches that of the species and there is no evidence of intergradation.

E. Engelmannii (Parry) Rumpler var. chrysocentra Engelm. & Bigel.

We have had several opportunities to observe this form in southern Arizona. Collections were made near Sells, Pima County (Fosberg & Pierce, April 2, 1932). It was also observed at Gunsight and in the Sonoita Valley, both in Pima County. It usually seems to inhabit the talus slopes of lava or porphyry buttes, although in the Sonoita Valley it was seen on open alluvial fans. At Gunsight where the range of the species touches that of var. chrysocentra at the foot of the peaks, plants were observed which seemed to be intergrades. The species did not occur on the slopes of the peaks at all, while the variety was common there. Var. chrysocentra is based entirely on the long straight slender spines which are of a greenish yellow color. The blossoms are like those of the species. This is the plant which has been known in collections by the specific name Meadei, a name which originated no one seems to know where, evidently never published.

Considering the tremendous range of variation in Echinocereus Engelmannii one hesitates to recognize any segregates from it, even of varietal rank. In the species itself the plants range from as short as 1 dm. to as tall as 5 dm.; the spines from 1 to 6 cm. in length, from straight to quite curved and in color from white through straw yellow, orange, brown and gray to bright ebony black, often with more than one color on the same plant. These variations seem to have little or no relation to geographic distribution or even to environmental conditions. The reason for recognizing the two varieties is that they present rather distinctive characters in more or less constant combinations and are geographic entities.

Cereus (Lophocereus) Schottii Engelmann.

Doubt has been expressed as to the occurrence of this plant in the United States. The junior author visited the Sonoita Valley in Pima County, Arizona and saw a considerable stand of it some distance from the boundary on the United States side. The plants seemed to be in a rather unhealthy condition.

Echinocactus (Ferocactus) acanthodes Lemaire.

The form of this plant described as Ferocactus Rostii Britton and Rose (Cactaceae III, p. 146) has been observed rather closely through a large part of its range on the western side of the Colorado Desert and we have decided that it does not apparently deserve even varietal rank. Plants of this form can be found in almost any large stand of E. acanthodes except from the most northerly portions of its range. It can only be considered an extreme in the variation of the species predominant in the southwestern part of its range, just as the low form which when young has very long bright red spines is the predominant form in the mountains of the eastern Mojave Desert. These forms could only be satisfactorily disposed of at present in a list of minor variations such as Hall has used in his revisions in the Compositae. Genetic studies might give a further understanding of them.

Neomammillaria microcarpa (Engelmann) Britton & Rose.

We found the plant described as Mammillaria Olivae by Orcutt (West. Amer. Scientist 12, p. 163) on a low quartzite knob near Colossal Cave, north of Vail, Pima County, Arizona (Fosberg & Pierce, April 3, 1932), and were immediately struck by its resemblance to N. microcarpa with which it was growing. Both were in fruit and we compared the two plants, their fruits and seeds. No difference whatever could be found except in the central spines which were short and straight in the Olivae form and longer and hooked in N. microcarpa. After further search we found a number of plants which had both kinds of spines on the same plant and all graduations between the two. North of Magdalena, Sonora, Mexico, we also found the straight spined form. Here it was growing on the flat valley floor. With it again were plants of the normal form and some with both kinds of spines and intermediates (Fosberg & Pierce, April 6, 1932). We think that the straight spined form is merely an occasional variation of N. microcarpa. The slight difference in the shape of the perianth parts in Britton and Rose's descriptions (Cactaceae IV, pp. 135, 155) seem well within the limits of variation in the species, and color differences are of very little importance, sometimes changing with the age of the flower and the time of day. We have seen a similar straight spined plant of Neomammillaria dioica (K. Brand.) Britt. & Rose (see Fosberg, Bulletin of So. Calif. Acad. Sci., V. XXX, pt. 2, p. 54). Another possibility is that the straight spined form may be a dying species or variety being submerged

by hybridization with N. microcarpa. The latter is a wide spread and quite variable species generally distributed over southern Arizona, Sonora, southern New Mexico, Chihuahua and southwestern Texas.

Neomammillaria (Phellosperma) tetrancista (Engelmann) Fosberg.

We are able definitely to record this plant from the Mojave Desert. We collected it in the Granite Mountains east of Victorville, San Bernardino County, California (Pierce, May 15, 1922) (Fosberg & Pierce No. 51525) and the senior author has examined in cultivation a specimen collected by Mr. Lee Chambers near the Ord Mountains.

PROCEEDINGS OF THE ACADEMY

October, 1932 to September, 1933

REGULAR MEETINGS

The regular meetings of the Academy are held the second Saturday evening of each month at 7:30 p. m. in the Lecture Room of the Los Angeles Library.

October 8, 1932: The guest speaker of the evening, Eugene O. Murman, of Glendale, gave an illustrated lecture on "Insectivorous Plants of the World." The large audience which was present, greatly enjoyed Mr. Murman's interesting account of the curious habits of insectivorous plants. The speaker, who is an accomplished artist, illustrated his talk with beautiful hand-colored slides made from his drawings.

November 12, 1932: Dr. John A. Comstock, Associate Director, Los Angeles Museum, gave his lecture "Adventures of a Butterfly Hunter," illustrated with stereopticon slides. Dr. Comstock gave an interesting account of collecting experiences in Florida and California, and showed many beautiful hand-colored views of butterflies in the egg stage, as larvae and as adults.

December 10, 1932: "Rattlesnakes of the Southwest" was the title of the illustrated lecture of Mr. L. M. Klauber of the Zoological Society of San Diego. This well-known herpetologist described the various kinds of rattlesnakes found in this region and discussed the relative strength of the poison in different species.

January 14, 1933: Dr. F. D. Blakeslee lectured on "The Panama Canal," illustrated with colored views.

February 15, 1933: Phil Townsend Hanna, Editor of Touring Topics, gave his illustrated lecture, "The Mother of California." He presented a vivid picture of the natural history and the people of Lower California, Mexico.

March 11, 1933: "Camouflage in Nature" was the subject of the illustrated lecture of Mr. Frederic S. Webster, formerly of the Carnegie Museum, Pittsburgh. His collecting of slides was well chosen and he gave the audience a most instructive talk.

April 8, 1933: Dr. Carl S. Knopf, of the University of Southern California, spoke on "The Archaeology of the Near East." The lecture was illustrated with lantern slides which showed the results of recent archeological expeditions.

May 13, 1933: An audience which taxed the capacity of the lecture hall, heard Mr. W. Scott Lewis lecture on the timely subject, "California Earthquakes." His slides illustrated many features in the geology of California.

June 10, 1933: "The Flowers of Hawaii and Their Legends" was the topic of Mr. Ralph Cornell, Los Angeles landscape artist, who illustrated his talk with many beautiful lantern slides of the flowers of the Hawaiian Islands.

BOARD MEETINGS

During the year, meetings of the Board of Directors were held on October 17, January 16, May 29 and July 24. Business was transacted relative to the disposal of the Schrader estate, election of Board members, appointment of committees, authorization for expenditures and selection of speakers.

ANNUAL MEETING

The annual meeting of the Academy was held the evening of June 19 at 6:30 o'clock in the Casa De Rosas Inn. After dinner, short speeches were made by Dr. John A. Comstock, Mr. William A. Spalding and President Payne. The reports of the Treasurer, Mr. Harry K. Sargent, and the Secretary, Mr. Howard R. Hill, were read and approved. The speaker of the evening, Mr. B. R. Baumgardt, F. R. A. S., delivered a splendid address on "The Romance of Human Progress." His lecture dealt with the scientific achievements of the past, the discoveries of the present day and the relation of science to the progress of mankind.

A count of the ballots returned by mail from members, showed the members of the Board of Directors re-elected by unanimous vote.

APPOINTMENT OF COMMITTEES

Publication: Mr. Spalding and Dr. Comstock.

Finance: Mr. Spalding.

Program: Mr. Hill, Dr. Comstock and Dr. Knopf.

SPECIAL MEETING

In coöperation with the Los Angeles Museum, the Academy held a special meeting on Sunday afternoon, August 6, in the lecture room of the Museum. Members of the Academy and their friends listened to a lecture by Mary L. Jobe Akeley, the wife of the late Carl Akeley, noted African naturalist and explorer. Her subject, "Carl Akeley's Africa," was presented in an interesting way and illustrated with slides and moving pictures taken in the field.

Howard R. Hill, *Secretary*

WILLIAM S. WRIGHT

William S. Wright, since 1922 Curator of Insects and County Supervisor of Nature Study on the staff of the Natural History Museum, Balboa Park, San Diego, died on July 8, 1933. He was born in Plaino, Illinois, April 23, 1866, and came to San Diego thirty-nine years ago. For twenty-eight years he was associated with the San Diego City Schools as a manual training teacher, maintaining at the same time a strong interest in his hobby of entomology, particularly Lepidoptera.

After joining the staff of the Natural History Museum he donated his collection of some 30,000 insect specimens, also his entomological library, and these provided the nucleus of the Museum's present collection, built up under Wright's curatorship to about 200,000. He was regarded as a national authority on the Geometridae.

As San Diego County Supervisor of Nature Study, he initiated a system for the rural schools which aroused great interest on the part of the children. Miss Ada York, San Diego County Superintendent of Schools, in commenting upon his death, wrote: "In the passing of W. S. Wright the schools of San Diego County have sustained an educational loss. Through his personal visits to the schools, through his bulletins, and through his correspondence with pupils, he greatly enriched the lives of all children who came under his direction."

Wright died shortly after starting his annual vacation, which he had planned to spend in Siskiyou County. Within three days of his death he was collecting butterflies there, when he complained of feeling ill and asked to be driven home. He died at Laguna Beach, en route to San Diego. He is survived by his wife, two daughters, three sons, two brothers, and five grandchildren.

He was a charter member of the San Diego Museum Association, former Secretary of the San Diego Society of Natural History, and a 32nd Degree Mason. He was a contributor to entomological and nature study magazines and had read papers at a number of scientific gatherings in California. In the Transactions of the San Diego Society of Natural History he published "An Annotated List of the Butterflies of San Diego County."

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Bulletin of the
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Bulletin, Southern California Academy of Sciences

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BULLETIN OF THE

Southern California Academy *of* Sciences

LOS ANGELES, CALIFORNIA

Vol. XXXIII January - April, 1934 Part 1

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Issued Feb. 28, 1934

Southern California Academy of Sciences

NEW OYSTERS AND A NEW PECTEN FROM THE TERTIARY OF CALIFORNIA

Leo George Hertlein

Ostrea ashleyi Hertlein, new species

Plate 1, figures 2 and 3; Plate 2, figure 1

Lower valve narrowly oblong, wider at base; exteriorly ornamented by numerous fluted ribs; area of attachment near beak unornamented. Interior of margin not folded; muscle scar fairly large; ligament groove long and fairly wide. Upper valve long and narrow; on the interior beneath the beak a long narrow elevated area is present which fits into the groove of the lower valve. Height of shell (beak to base, incomplete), 216 mm.; width of shell (at base) 108 mm.

Holotype: Lower valve, No. 6065 (C. A. S. type coll.) from Loc. 933 (C. A. S.) Kern County, California; Chas. Morrice collector; Temblor, Miocene [= Loc. 981 (C. A. S.) near the center of Sec. 32, T.28 S., R.29 E., M. D. M. F. M. Anderson collector. Temblor, Middle Miocene]. Paratype: upper valve No. 6072 (C. A. S. type coll.) from Loc. 1073 (C. A. S.), from forks of large gulch which runs from the north through the middle of the E. ½ of Sec. 28, T.28 S., R.29 E., M. D. M., Kern County, California; about one kilometer above falls on central hill slope; G. D. Hanna collector; Temblor, Miocene. A paratype of this species has been deposited at the San Diego Society of Natural History, San Diego, California.

This species is abundant at Loc. 1073 (C. A. S.). Mr. A. R. May of Bakersfield, California, has studied the field relationship at this locality, and kindly furnished the following information:*

"Locality No. 1073 occurs on the east bank of the creek about twenty feet above the creek bed, at an elevation of approximately 710 feet. The Round Mountain Silt-Olcese Sand ("Middle Temblor Sands") contact occurs on the hill side to the east of the locality at an elevation of 925 feet. The dip of the beds is about 5 degrees to the south and the oyster bed consequently is between 200 and 210 feet below the top of the Olcese Sand."

This long narrow oyster with pronounced ribs ornamenting the lower valve, which bears a long ligament groove, internally, is quite distinct from any other species from western North

*Written communication to Dr. G. D. Hanna, dated November 8, 1933. Letter in files of the California Academy of Sciences.

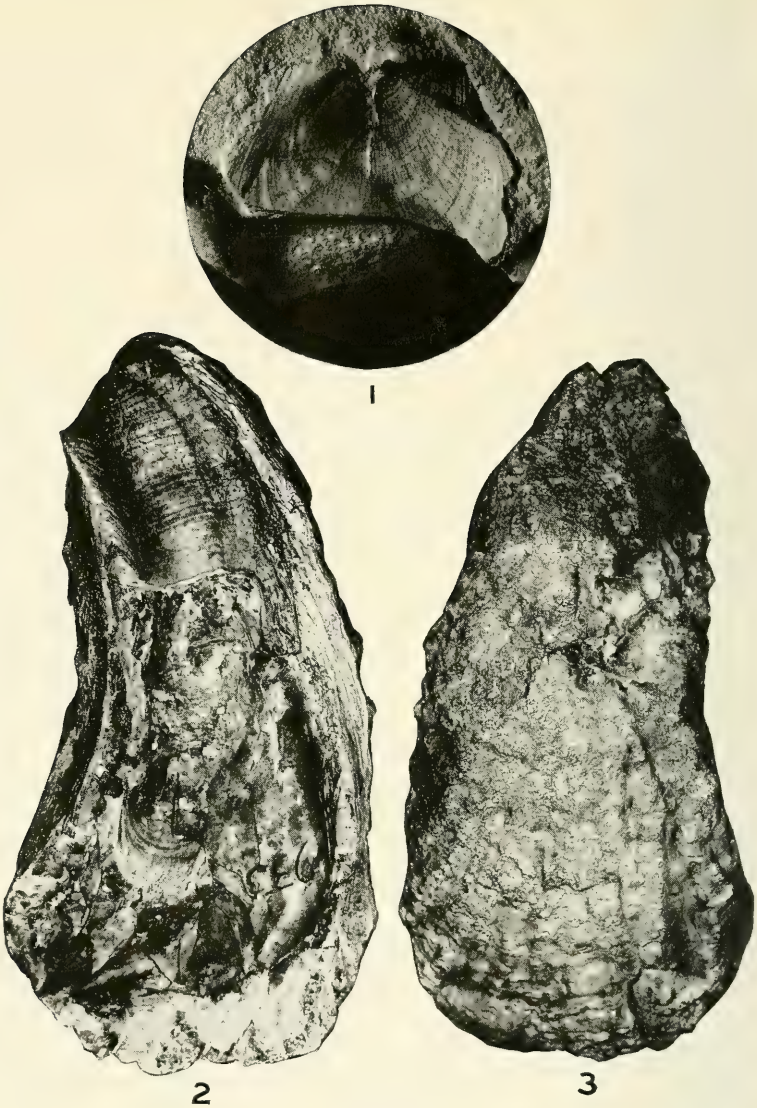

PLATE 1

FIG. 1. *Pecten* (*Pseudamusium*) *lillisi* Hertlein, new species. Paratype: left valve, No. 6063 (C. A. S. type coll.) from Loc. 1874 (C. A. S.) diatomite from S. E. corner of Sec. 35, T. 6 S., R. 7 E., M. D. M., Stanislaus County, California, north side of Crow Creek road. Bedded material in quarry, dip nearly flat. G. D. Hanna and J. A. Taff, collectors; Kreyenhagen formation, upper Eocene or lower Oligocene. Height of figured specimen (incomplete) approximately 20.5 mm., length (incomplete) approximately 16.5 mm.

FIG. 2. *Ostrea ashleyi* Hertlein, new species. Holotype: lower valve, No. 6065 (C. A. S. type coll.) from Loc. 933 (C. A. S.) Kern County, California; Temblor, Miocene. Chas. Morrice collector. [= Loc. 981 (C. A. S.) near center of Sec. 32, T. 28 S., R. 29 E., M. D. M. F. M. Anderson collector; Temblor, Miocene.]

FIG. 3. *Ostrea ashleyi* Hertlein, new species. Exterior of same specimen as figure 2.

America. These features of the lower valve as well as the long narrow upper valve with the internally raised area below the beak, easily distinguish the species from other lower Miocene forms such as *O. loeli* Hertlein,[1] *O. wiedeyi* Hertlein,[2] and *O. howelli* Wiedey.[3]

In some cases this species has apparently been referred to *O. bourgeoisii* Rémond.[4] Rémond's type was not illustrated at the time of description and it is possibly lost. Gabb[5] published a figure of an oyster which he referred to *O. bourgeoisii* but he did not definitely state whether or not the figure represents Rémond's type specimen, which came from Kirker's Pass in Contra Costa County, California. Clark[6] has figured as *O. bourgeoisii,* an oyster stated to be of common occurrence in the upper Miocene, but the exact locality from which the figured specimen came is not definitely stated. *O. bourgeoisii* appears in his checklist, but under the list of localities accompanying the same, the indication as to locality is omitted. The form figured by Clark is quite distinct from *O. ashleyi* which occurs in the Temblor.

Specimens of oysters in the collections of the California Academy of Sciences, which can apparently be referred to *O. bourgeoisii,* occur in the beds which have been referred to the San Pablo formation in Contra Costa County and at other localities in the Mount Diablo region. Some of the localities are here mentioned. Loc. 27640 (C. A. S.) N. W. ¼ Sec. 27, T.3 S., R.3 E., M. D. M. About five miles east of Livermore, Alameda County, California. Loc. 25716 (C. A. S.) Sec. 5, T.3 N., R.3 E., M. D. M., two miles southeast of Greenville, Contra Costa County, California. Loc. 27620 (C. A. S.) Oyster Shell Hill, N. W. corner of Sec. 3, T.3 S., R.3 E., M. D. M. Alameda County, California; Basal San Pablo. Loc. 27631 (C. A. S.) N. E. side of hill 1318, N. E. ¼ of N. W. ¼ Sec. 15, T.2 S., R.2 E., Alameda County, California.

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[1] Jour. Paleo. vol. 2, no. 2, 1928, p. 147, pl. 23, figs. 1, 10.

[2] Jour. Paleo. vol. 2, no. 2, 1928, p. 144, pl. 22, figs. 2 and 3.

[3] Trans. San Diego Soc. Nat. Hist. vol. 5, 1928, p. 135, pl. 15, figs 1 and 2.

[4] Proc. Calif. Acad. Sci., vol. 3, 1863, p. 13. "Vicinity of Kirker's Pass, from a late Tertiary bed."

[5] Geol. Survey Calif., Palaeo. vol. 2, 1866, p. 33, pl. 11, figs. 57, 57a. In the text the locality is given as "Near Kirker's Pass, Contra Costa County; from the Pliocene."

[6] Univ. Calif. Publ. Bull. Dept. Geol. vol. 8, no. 22, 1915, p. 447, Pl. 43.

1

2

3

PLATE 2

FIG. 1. *Ostrea ashleyi* Hertlein, new species. Paratype, upper valve, No. 6072 (C. A. S. type coll.) from Loc. 1073 (C. A. S.) from forks of large gulch which runs from the north through the middle of the east ½ Sec. 28, T. 28 S., R. 29 E., Kern County, California. About ½ kilometer above falls on central hill slope; G. D. Hanna and J. A. Taff collectors; Temblor, Miocene. Central ligament ridge elevated about 10 mm. above the plane of the hinge.

FIG. 2. *Pecten* (*Pseudamusium*) *lillisi* Hertlein, new species. Holotype, impression of right valve, No. 6062 (C. A. S. type coll.), from the same locality as the specimen illustrated on Plate 1, figure 1.

FIG. 3. *Pecten* (*Pseudamusium*) *lillisi* Hertlein, new species. Enlarged view of the anterior portion of the specimen in figure 2.

Ostrea titan eucorrugata, new name.

Ostrea titan corrugata Nomland, Univ. Calif. Publ. Bull. Dept. Geol. vol. 10, no. 18, 1917, p. 306, pl. 16, fig. 1; pl. 17, fig. 1; "near middle of southern boundary of N. E. ¼ Sec. 10, T.19 S, R.15 E, M. D. B. & M., about fifty feet above base of formation." Santa Margarita formation, upper Miocene.

Not *Ostrea corrugata* Brocchi, Conch. Fossil. Subapennina, vol. 2, 1814, p. 670, pl. 16, figs. 14 and 15; "fossile nel Piacentino."

Not *Ostrea corrugata* Hutton, Catalog. Tert. Moll. & Echin. New Zealand, 1873, p. 35; "Shakespeare Cliff."

Nomland has indicated that this form is "Distinguishable from the typical *Ostrea titan* Conrad which is also found in the Santa Margarita formation by the prominent folds on surface and the greater convexity of lower valve."

Hanna[7] has already pointed out that the name *corrugata* is preoccupied in the genus *Ostrea* by *O. corrugata* Brocchi. The California form named *corrugata* by Nomland is believed by some workers to have a stratigraphical significance, and is therefore renamed.

Hutton has also used the name *O. corrugata* for a New Zealand fossil shell, which has been renamed *Ostrea huttoni* by Lamy.[8]

Pecten (Pseudamusium) lillisi Hertlein, new species
Plate 1, figure 1; plate 2, figures 2 and 3

Shell small, of general form of *Pecten pedroanus* Trask; right valve, the anterior ear well defined, set off from the rest of the shell by a well defined groove, a well developed byssal notch is present; anterior ear ornamented by six or seven riblets, which are crossed by imbricating lines of growth; posterior ear unornamented except by fine lines of growth; the anterior portion of the valve ornamented by about ten fine spinose riblets; the posterior portion of the valve unornamented except by fine lines of growth; entire surface of valve covered by fine submicroscopic camptonectes striations which cross the radiating riblets. Measurements of holotype, altitude 14.1 mm.; length (approximately) 13 mm.; length of hinge line 9.2 mm.

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[7] Proc. Calif. Acad. Sci. ser. 4, vol. 13, no. 10, 1924, p. 174.

[8] Jour. de Conchyl. vol. 73, no. 3, 1929, p. 166.

Left valve (paratype), the anterior ear is ornamented by about six to eight fine radial ribs; the surface of the valve is ornamented by fine radiating riblets; entire surface covered by camptonectes striations similar to the right valve.

Holotype: No. 6062 and paratypes, Nos. 6063 and 6064 (C. A. S. type coll.) from Loc. 1874 (C. A. S.) diatomite, Kreyenhagen shale, from S. E. corner of Sec. 35, T.6 S., R.7 E., M. D. M., Stanislaus County, California; on the north side of Crow Creek road. Bedded material exposed in quarry, dip nearly flat. G. D. Hanna and J. A. Taff collectors. Kreyenhagen formation; upper Eocene or lower Oligocene. The holotype and paratypes are excellent impressions in the white diatomaceous shale.

Pecten lillisi may be distinguished from *P. pedroanus* Trask and other fossil and Recent species of small pectens on the west coast of North America, by the small number of delicate spinose ribs which ornament the anterior portion of the right valve, and by the fine submicroscopic camptonectes striations which cover the surface of the shell. The less numerous ribs on the right valve distinguish the new species from *Pecten (Pseudamusium) panamensis* Dall.[9] Compared to *Pecten (Pseudamusium) reticulus* Dall,[10] the new species differs in the shape of the ears and in the greater number of radiating riblets on the left valve; also the anterior portion of the right valve possesses more radiating riblets than the species described by Dall. No mention is made by Dall in the description, regarding the presence of any camptonectes striations on *P. reticulus*. *Pecten (Pseudamusium) thalassinus* Dall,[11] described but apparently unfigured, is said to be ornamented similar to *P. reticulus* but with the sculpture less pronounced. The strong spines on the ribs of the right valve, strongly sculptured ears, and camptonectes striations of *P. lillisi* serve to distinguish it from Dall's species.

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[9] Bull. Mus. Comp. Zool. vol. 43, no. 6, 1908, p. 404, pl. 6, figs. 8 and 10. "Gulf of Panama, in 322 fathoms, mud, bottom temperature 56° F." . . . . "ranging from near Acapulco, Mexico, to the Galapagos Islands, in 141 to 885 fathoms, soft bottom, temperature 37°.2 to 53°.5 F."

[10] Bull. Mus. Comp. Zool. vol. 12, no. 6, 1886, p. 221, pl. 5, figs. 8 and 10. "Obtained in 82-123 fms. at Barbados."

[11] Bull. Mus. Comp. Zool. vol. 12, no. 6, 1886, p. 221. "80 to 317 fms. off Martha's Vineyard," and "off Havana in 450 fms."

FOSSIL MOLLUSKS FROM THE VERTEBRATE-BEARING ASPHALT DEPOSITS AT CARPINTERIA, CALIFORNIA

By U. S. Grant and A. M. Strong

Introduction

In 1927 an asphalt deposit on the Lucien Higgins Ranch at Carpinteria, Santa Barbara County, California, was discovered to contain numerous remains of vertebrate animals. The importance of this discovery was recognized by the late Mr. Ralph Hoffman and Mr. Norton Stuart of the Santa Barbara Museum of Natural History, who invited Dr. Ralph Chaney and Dr. Chester Stock to investigate the deposit. This resulted in the collection of a large number of remains of birds, mammals and plants, some reports on which have already appeared.[1]

Somewhat later Mr. David Banks Rogers[2] of the Santa Barbara Museum of Natural History made a collection of marine invertebrates from the lower three or four inches of sand immediately below the asphalt impregnated vertebrate beds and lying on the inclined truncated Miocene Monterey shales. Through the kindness of Mr. Rogers we were permitted to study the Mollusca which form the basis of the faunal list included herewith.

Previous Work

In a preliminary report[3] Messrs. Chaney and Mason stated that the fossil flora indicated a forest assemblage dominated by coniferous trees with a heavy undergrowth of shrubs and herbs. All the readily recognized plants were of species identical or similar to species now living in California but only where the rainfall was greater than that now prevailing at Carpinteria. They concluded the age of the plants must be Pleistocene. Loye Miller,

---

[1] Hoffman, Ralph: "The finding of Pleistocene Material in an Asphalt Pit at Carpinteria, California," Science, N. S., Vol. 66, no. 1702, p. 155, Aug. 12, 1927.

Stock, Chester: "Pleistocene Fauna and Flora," *op. cit.*, pp. 155-156.

Miller, Loye: "Bird Remains," *op. cit.*, p. 156.

Chaney, Ralph W. and Mason, Herbert L.: "Fossil Plants," *op. cit.*, pp. 156-157.

Miller, Loye: "Pleistocene Birds from the Carpinteria Asphalt of California," Univ. Calif. Publ. Bull. Dept. Geol. Sci., Vol. 20, no. 10, pp. 361-374, 4 text figs., Aug. 4, 1931.

Miller, Alden H.: "The Fossil Passerine Birds from the Pleistocene of Carpinteria, California," Univ. Calif. Publ. Bull. Dept. Geol. Sci., Vol. 21, no. 7, pp. 169-194, pls. 12-14, Feb. 26, 1932.

Wilson, Robert W.: "Pleistocene Rodent Fauna from the Carpinteria Asphalt Deposits," Abstract. Bull. Geol. Soc. America, Vol. 44, pt. 1, pp. 219-220, Feb. 28, 1933.

Chaney, Ralph W. and Mason, Herbert L.: A Pleistocene Flora from the Asphalt Deposits at Carpinteria, California. Carnegie Inst. Publ. No. 415, pp. 45-79, pls. 1-9, March, 1933.

[2] According to Mr. Rogers the invertebrates came from a pit 300 feet north of the embankment at the beach, 230 feet south of the south boundary of the Southern Pacific R. R. right of way, and 850 feet west of the east line of the Higgins Estate. The present authors were not able to inspect the site.

[3] Chaney, Ralph W. and Mason, Herbert L., *op. cit.*, 1927, p. 157.

who studied the avian remains (except the Passerines), believed[4] that some of the fossil birds sugested a sylvan coastal region cooler and more nearly a Transition life zone than either the Pleistocene vertebrate deposit at McKittrick in the San Joaquin Valley or the Rancho La Brea deposit in the city of Los Angeles. Alden H. Miller, who studied the fossil passerine avifauna, concluded[5] that the assemblage "could be duplicated today in the region of Monterey with the exception of *Corvus caurinus,* breeding robins, and the possible extinct types." The rodent material, as studied by Wilson,[6] suggested that the deposit was accumulated at the edge of the forest during late Pleistocene time.

In the final report on the fossil plants by Chaney and Mason[7] it was concluded that the climate at Carpinteria during the time of accumulation of the flora was "cooler and slightly more humid than it is today, and was more like that on the coast 200 miles to the northwest where the summers are moist and cool." These authors arrived at a similar conclusion[8] in regard to the climate during preservation of the fossil flora discovered a few years ago on Santa Cruz Island, one of the Santa Barbara Channel group lying about 30 miles off the shore of southern Santa Barbara County. In both cases forest conditions such as now prevail on the Monterey Peninsula about two hundred miles north of Carpinteria extended south into southern California. This extension southward of northern conditions during the Pleistocene in California is well established by the abundant Quaternary molluscan fossil remains in Los Angeles County. It is unfortunate that the molluscan fauna associated with the Carpinteria plants and vertebrates is almost too small to give a very positive independent check on the climatic conditions indicated by the other organisms, but the species identified from the collections made by Mr. Rogers, taken all together, suggest a marine temperature slightly cooler than that now prevailing on the shores of southern Santa Barbara County.

The Molluscan Fossils

Since the occurrence of fossil marine invertebrates in association with land plants and vertebrates is of rare occurrence it seems desirable to place on record all information, however meagre, based on all the organisms represented. The following list includes all the marine Mollusca from the Carpinteria asphalt deposit which we were able to identify in the collections submitted to us by Mr. David B. Rogers.

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[4] *Op. cit.*, 1927, 1931.

[5] *Op. cit.*, p. 185.

[6] *Op. cit.*, p. 220.

[7] *Op. cit.*, 1932. See pp. 75, 76-77, 78-79.

[8] Chaney and Mason, Carnegie Inst. Wash., Publ. No. 415, no. 1, 1930. The Santa Cruz Island Pleistocene flora suggests slightly cooler and more humid conditions than that of Carpinteria.

Pelecypoda

Ostrea cf. *lurida* Carpenter.
Hinnites multirugosus (Gale).
Pecten (Aequipecten) latiauratus Conrad.
Pecten (Aequipecten) delosi Arnold.
Mytilus sp. 3 young valves.
Glans carpenteri (Lamy).[9]
Lucina (Lucinisca) nuttallii Conrad.
Venerupis (Protothaca) staminea (Conrad).
Tellina bodegensis Hinds.
Macoma nasuta (Conrad).
Cumingia lamellosa Sowerby.
Schizothaerus nuttallii (Conrad).

Scaphopoda

Dentalium neohexagonum Sharp and Pilsbry.

Gastropoda

Conus californicus Hinds.
Moniliopsis incisa (Carpenter).
Mangelia (Bela) variegata Carpenter.
Mangelia (Bela) hecetae Dall and Bartsch.
Clathurella affinis Dall.
Olivella biplicata (Sowerby).
Hyalina (Cystiscus) jewetti (Carpenter).
Nassarius (Schizopyga) perpinguis (Hinds).
Nassarius (Schizopyga) mendicus (Gould).
Nassarius (Schizopyga) mendicus, var. *cooperi* (Forbes).
Nassarius (Schizopyga) fossatus (Gould).
Mitrella carinata (Hinds).
Mitrella carinata, var. *gausapata* (Gould).
Amphissa reticulata Dall.
Tritonalia interfossa (Carpenter).
Tritonalia lurida (Middendorff).
Acanthina spirata (Blainville).
Bittium (Semibittium) quadrifilatum Carpenter.
Turritella cooperi Carpenter.
Tachyrhynchus ? reticulatus (Mighels).
Lacuna unifasciata Carpenter.
Hipponix antiquatus (Linnaeus).
Crepidula adunca Sowerby.
Crepidula nummaria Gould.
Crepidula sp.
Polinices (Euspira) lewisii (Gould).
Acmaea sp.

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[9] Described as *Lazaria subquadrata* Carpenter, 1864, and long known as *Cardita subquadrata* (Carpenter). Not *Cardita subquadrata* Conrad, 1848. Renamed *Cardita (Carditamera) carpenteri* Lamy, Journ. de Conchyl., Vol. 66, p. 264, 1921. *Glans minuscula* Grant and Gale, 1931, is an exact synonym.

Tricolia sp.
Calliostoma canaliculatum (Martyn).
Calliostoma costatum (Martyn).
Megatebennus bimaculata (Dall).
Epitonium (Nitidiscala) indianorum (Carpenter).
Turbonilla (Strioturbonilla) stearnsii Dall and Bartsch.
Turbonilla (Strioturbonilla) new species.
Turbonilla (Strioturbonilla) cf. *ralphi* Dall and Bartsch.
Turbonilla (Pyrgiscus) antestriata Dall and Bartsch.
Odostomia cf. *columbiana* Dall and Bartsch.
Odostomia cf. *donilla* Dall and Bartsch.
Odostomia cf. *jewettii* Dall and Bartsch.

Amphineura

Ischnochiton magdalenensis (Hinds).
Mopalia sinuata (Carpenter).
Mopalia ciliata (Sowerby).
Tonicella lineata (Wood).
Placiphorella velata Carpenter.

Ecology

As stated in a preliminary paper[10] the ecologic requirements of these molluscan species suggest that they probaly lived in a semi-sheltered cove or open embayment embracing rocky tide pools and lagoonal conditions in close proximity. Such a varied habitat can be found at many places along the present California coastline where small canyons meet the sea along rocky coasts.

Of the 57 forms represented in the above list, 46 are definitely determined species, including the 5 Amphineura. All are still living[11] and most of them include Santa Barbara County in their known Recent ranges. At first sight the fauna appears to represent a typical southern California assemblage but the *Tachyrhynchus* (questionably identified as *reticulatus*) might be the northern species and two chitons, *Mopalia sinuata* (Carpenter) and *Tonicella lineata* (Wood), are primarily northern in their range though the latter has been recorded as far south as San Diego. Though the fauna is small it precludes the possibility of warmer marine conditions than the present for it does not include the well known living southern forms such as *Laevicardium elatum* Sowerby, *L. procerum* Sowerby, *Mulinia modesta* Dall, *Tellina rubescens* Hanley, *Chione gnidia* Broderip and Sowerby, *Crassispira amathea* Dall, *Eupleura muriciformis* (Broderip), *Macron aethiops kellettii* (A. Adams), *Centrifuga leeana* (Dall), and *Purpura monoceros* (Sowerby) which are present in the warm water late Pleistocene

[10] Grant, U. S. and Strong, A. M.: "Fossil Mollusca from the base of the vertebrate-bearing asphalt pits at Carpinteria, California," a paper read at the meeting of The Paleontological Society, Pacific Coast Branch, held at Los Angeles, California, April 8, 1933.

[11] *Pecten* (*Aequipecten*) *delosi* Arnold, originally described as a fossil, is now known to be living in southern California waters.

Palos Verdes formation of Los Angeles County. Thus, the Carpinteria fossil mollusks suggest marine conditions probably slightly cooler than the present.

Geologic Age

In regard to the age of the deposit, the lack of extinct species would place it in the late Pleistocene, later than the Palos Verdes formation which has some extinct species[12] and which has been correlated[13] with the Sangammon interglacial stage of the Pleistocene. But the small number of definitely determined species makes this conclusion somewhat questionable for there may be extinct species in the deposit which have not been preserved, or at least have not been collected. On other grounds, however, a late Pleistocene age appears to be a safe conclusion for out of 25 species of plants only one is extinct and the vertebrates are also suggestive of the late Pleistocene. In view of the apparent recency of all the organisms, and their climatic significance, the Carpinteria asphalt deposit may be tentatively dated toward the latter part of the late Wisconsin glacial stage of the Pleistocene when the lowest temperature had been passed and conditions were becoming somewhat ameliorated.

Correlation

The closest equivalent of this fauna appears to occur in the fossiliferous fine sandstone which is exposed in the low terrace southwest of Goleta, ten or fifteen miles west of Carpinteria. A preliminary list of the mollusks from the Pleistocene southwest of Goleta was published by I. S. Oldroyd and U. S. Grant (Nautilus, Vol. 44, pp. 91-94, 1931). Much larger collections obtained later add a number of species to the fauna. Fifty-six per cent of the Carpinteria molluscan fauna also occur in the Goleta terrace deposits on the Campbell Ranch, the differences being probaly due to ecology rather than the passage of time. Less than one-third of the Carpinteria fauna ocurs in the Timms Point formation at San Pedro, and the San Pedro formation and the Palos Verdes formation each have very significant faunal differences. Chaney and Mason have named the Carpinteria deposits the Carpinteria formation,[14] a late Pleistocene horizon which very likely will be recognized at several other localities along the southern California coast wherever the present cycle of marine erosion has not completely destroyed the lower marine terraces produced during previous cycles.

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[12] Such as *Cantharus fortis* Carpenter, *Cancellaria Tritonidea* Gabb.

[13] See Grant and Gale, Mem. San Diego Soc. Nat. Hist., Vol. 1, p. 75, 1931.

[14] *Op. cit.*, 1933, p. 48.

NOTES ON THE INSECT INHABITANTS OF WOOD RAT HOUSES IN CALIFORNIA

By A. C. Davis

The insect fauna of the nests of various animals is a subject that has not to date received the attention of which it is worthy. Explorations of the living quarters of animals and birds may not only bring to light a certain number of undescribed species of insects, but will net a great amount of information upon the habits of insects already described, but about which little is known. The insects, chiefly Coleoptera, inhabiting the nests of ants and termites as guests of one kind or another have received the most attention. In England a good deal of work has been done upon the insect fauna of mole's nests by Beare and Evans (2), Joy (13) and others, and in continental Europe, Bickhardt (3) has enumerated the insects known to have been found in the nests of other animals. In North America a little work has also been done, although the surface has not been more than scratched. Hubbard's paper upon "The Insect Guests of the Florida Land Tortoise" (12) is a classic of its kind. Beamer (1) has published a paper upon the occurrence of a chrysomelid beetle, *Griburius montezumae* Suffr., in the nests of turkey vultures, Knaus (14) in a short paper summarizes the various places in which Coleoptera may be expected to be found as guests of other animals, and there are a number of other notes upon the subject, mainly very short or incidental to description. Among these the papers of Brown (4, 5, 6, 7) deserve mention, being in part the result of investigation of the burrows of the prairie dog, *Cynomys ludovicianus ludovicianus* (Ord.) in Oklahoma by Mr. Brown and of the burrows of the pocket gopher (*Thomomys talpoides talpoides* Rich.) in Canada by F. H. Strickland and S. Criddle.

I first became interested in the insect fauna of the wood rat houses about 1925, when R. E. Barrett, now of Saticoy, Calif., was collecting Coleoptera from them as the subject of a thesis. Mr. J. O. Martin, of the California Academy of Sciences, had perviously done a great amount of work upon the nests. Neither collector ever published his findings, and both have very kindly given me permission to incorporate their data with my own in the present paper.

Wood rats of the genus *Neotoma* form a large group of characteristic mammals not closely related to the Old World rats of the genus *Rattus,* and with entirely different habits. Generally they are harmless and interesting inhabitants of uncultivated lands and only occasionally do any serious damage to man's property and are then easily controlled. Some of the species are about the size of the common brown rat (*Rattus norvegicus*), some larger and some smaller. They have large ears, bright eyes, and a rather pleasing expression of intelligence. They are cleanly in habits

although their old houses and nests are often filled with food refuse and trash from many years of accumulation, and this refuse and the extensive deposits of excrement attract and harbor many forms of insect life.*

In California there are more than a dozen species and subspecies of wood rats belonging to several distinct groups with different habits and habitats, but all are builders. Some build large stick houses on the ground or in trees, others out in the deserts among cactus and thorn bushes, and others among rocks or in caves and old buildings. Their houses of many years' accumulation are sometimes bulky affairs of sticks and trash 5 or 6 feet high, or in the deserts low mounds of cactus and thorns, or in tree tops great bunches of sticks and leaves among the branches, or among rocks mere heaps of sticks and stones to cover the doorways back into their nest cavities.

The nests are generally cup-shaped beds of fine soft bark or plant fibers in well-protected cavities or chambers inside or under the main houses, and generally there are considerable food stores near the nests or in special cavities provided for the purpose.

The houses of the wood rat, *Neotoma fuscipes macrotis* (Thomas), locally known as the brush rat or trade rat, are to be found along the bottom and slopes of almost any brushy canyon in California. They are built of loose twigs and sticks, and are usually somewhat conical in shape, varying from a few handfuls of twigs to huge structures 6 feet or more high and as many feet in diameter at the base. Usually they are built around some bush or small tree, but occasionally they are in the open. I have opened several that were built upon large rocks, deep fissures in which gave a final retreat for the rats. One house examined was merely a nest chamber in a crevice in a large rock. Frequently the rats will build a house high up in a tree, but this often serves merely as a retreat in time of danger.

The rats incorporate into their houses anything that strikes their fancy, and there seem to be very few things that may not be made use of. I have seen splintered sections of shovel-handles, surveyor's stakes, broken bottles, bits of glass, pieces of cactus, tin cans, nails, bailing-wire, automobile bolts, pieces of inner tubing, and a host of other articles. Anything that is small enough for the rat to carry (and they can drag off surprisingly large articles) and that is not nailed down will serve some rat at some time as building material. In opening the houses it pays to go carefully if painful cuts and scratches are to be avoided.

The pile of sticks and other material is traversed by galleries running in different directions and opening at different levels, and there is often an underground exit also. The nest chamber proper,

*This paragraph and the two which immediately follow it were kindly furnished by the U. S. Bureau of Biological Survey.

containing the bed of the rat, is generally found somewhere near the lower center of the heap. The nest or bed is constructed of finely shredded dry grass and roots, the inner bark of trees, and sometimes a few feathers or a length or two of cotton string. It is about 6 inches in diameter, and has an entrance at one side.

The rats seem to prefer to deposit their faeces in a definite part of the house, but this varies in location. In some houses it is just at the entrance to one of the galleries and in others it may be just outside the bed, in the nest chamber. In the older houses or in those in which there are several rats the nest chambers may become too foul, and a new nest chamber and bed are constructed, usually at a higher level. In some houses the accumulation of faeces forms a mass several inches deep.

In some part of the house, usually adjacent to the nest chamber, there is a store of such food as may be in season. This may be berries, acorns, sumac seeds, small terminal twigs of various plants, etc., the store containing as much as 7 or 8 quarts at times.

Excellent accounts of the nests, habits, and food of these rats have been given by English (8), Gander (9), Grinnell and Storer (10, pp. 116-122), Grinnell, Dixon, and Linsdale (11, pp. 515-521), and Parks (15).

The insect inhabitants of the nests may be grouped into four major divisions:

1. Seasonal inhabitants, including those that use the nests as retreats for hibernation or aestivation, such as many of the Tenebrionidae found there, and the Coccinellidae.

2. Those brought into the nests with the building material or with food, such as the Ptinidae, which undoubtedly emerge from the sticks composing the houses.

3. Incidental, feeding upon other insects, faecal material, or fungus, and not peculiar to the nests.

4. Peculiar to the nests, feeding upon the material of the nests or houses, parasitic upon the rats, or parasitic or predacious upon other insects in the nests or houses.

Between 1925 and 1931 the writer has opened in the neighborhood of 500 nests, and at least as many were opened by Martin and Barrett. Most of these were examined in the rainy season, from October or November to April or May. There is little to be found in the houses in the dry season, and other collecting demands the attention of the entomologist.

In opening one of these houses the space about it was first cleared of brush if possible. Since many houses are built in among multiple trunks of large shrubs this could not always be done. The house was then pulled apart with a long-tined rake until the

nest and dung chambers were nearly or quite exposed. These and the material surrounding them were carefully lifted out with a trowel and the hands, and sifted, as was the humus, soil, and rotten vegetation at the ground level. At first the entire house was pulled apart stick by stick and shaken over a sheet, after the method of J. O. Martin, but this was found to be too tedious and lengthy in view of the scarcity of insects in the outer layers.

The screen used for sifting was given me by A. Fenyés, of Pasadena, Calif., and consisted of two rings of heavy wire with handles. The lower ring is covered with coarse screen. The two rings are connected by a canvas cylinder about 15 inches long, and a continuation of this cylinder hangs down about 34 inches from the bottom ring. This is tied at the bottom, forming a sack into which the sifted material falls. This material may be—as much of it was—placed upon a screen in the field and examined in bright light. However, many of the smaller insects will not move and so escape detection. A better method is to dump the sifted material into paper sacks and take it home where it may be examined at leisure. For later collecting a device for extracting the insects, made upon the principle of the Berlese funnel, was used, and proved very successful. This apparatus was also devised and given me by Dr. Fényes.

Owing to the difficulty of having material in so many different groups determined by specialists, many of the insects taken in the nests were not identified.

Thysanura

A species of "fish moth" was taken by Mr. Martin at Berkeley, and several specimens of what may be two species were taken by the writer from several houses in Orange County.

Collembola

No special effort was made to collect these minute insects, but numerous specimens of at least two species were seen in the nests.

Orthoptera

Parcoblatta americana Scudder. Several nymphs were taken from houses in Orange County.

Ceuthophilus sp. Mr. Martin found fragments in nests at Berkeley. Several specimens were taken in the lower galleries of houses in Orange County and at Pasadena and Griffith Park, Los Angeles County.

The two foregoing species were identified by A. N. Caudell.

Corrodentia

Psocidae were numerous in the nests.

Anoplura

Gander (9) reports that many of the rats are infested with lice. Of the seven or eight that I had an opportunity to examine none were infested.

Hemiptera

Eurygaster alternatus Say. Specimens were taken by Mr. Martin at Berkeley. It is probable that these were merely hibernating here.

Corizus spp. Two species of this genus were taken by Mr. Martin at Berkeley, in nearly all the nests. They are common on flowers, and had probably used the nests merely as a place of hibernation, as does *Dicyphus vestitus* Uhl., which was also found by Mr. Martin at Berkeley.

Plinthisus martini Van Duzee. Two specimens were taken at Berkeley by Mr. Martin. He regards it as a true inquiline.

Eremocoris inquilinus Van Duzee was taken by Mr. Martin at Berkeley and by E. P. Van Duzee near San Diego. This species seems to be peculiar to the wood rat nests and is probably a parasite of the rats, although it may be predatory upon other insects in the nests.

Triatoma protracta (Uhl.) is common in all stages in nearly all nests throughout the region, and seems a normal inhabitant. There is little doubt that it is regularly parasitic upon the rats. It has been shown to carry a disease of the rats caused by the protozoan *Trypanosoma triatomae*

Rashahus thoracicus Stal. Two specimens were seen in two different nests in Orange County. The insect is common in southern California, and these two were probably hiding during the day.

Apiomerus crassipes (Fabr.). This bug is not uncommon in the houses. Several were seen at Berkeley and at various points in southern California. They were probably using the houses as hibernation quarters. These bugs are capable of inflicting a very severe jab, as are *Triatoma* and *Rasahus*. I have not been bitten by the latter two, but can answer for *Apiomerus*.

Dermaptera

Several earwigs were seen in the nests from time to time, but none were collected.

Coleoptera

This order has probably more representatives in the fauna of the wood rat houses than all the others combined. A few of them are peculiar to the houses and are found nowhere else, but most of them are normally found in other places and are here only because they find suitable food or shelter during hibernation or metamorphosis.

Carabidae

Bembidion sp. Taken by Mr. Martin at Berkeley.

Pterostichus californicus (Dej.). Not uncommon in the houses, especially in the outer and lower portions, at Berkeley (Barrett), Pasadena, and in Orange County.

Pterostichus congestus Mén. Pasadena, quite common (Barrett). One specimen, Silverado Canyon, Orange County.

Hydrophilidae

Megasternum posticatum Mann. Not uncommon at Berkeley on January 27, 1927. R. E. Barrett, in his notes, records it as most common in January. J. O. Martin notes it as "fairly common here as elsewhere in decaying vegetable matter." Taken in the well rotted dung of the lower chambers.

Silphidae

One unidentified specimen belonging to this family was taken by Mr. Martin at Berkeley. I saw fragments of what appeared to be a *Choleva* or *Ptomaphagus* in sifted refuse from a house in Santiago Canyon, Orange County.

Orthoperidae (Corylophidae)

Eutrilia brunnea Csy. One specimen taken at Berkeley in November by Mr. Barrett. Mr. Martin also took this species. He records it as "found in decaying wood where fungus is growing," which would account for its presence in the wood rat houses.

Staphylinidae

Micropeplus laticollis Mäkl. This species was taken at Berkeley by Mr. Martin. Twelve examples were taken from three nests within a few rods of each other. Found in heaps of faeces.

Proteinus sp. Taken by Mr. Martin at Berkeley.

Phyllodrepa megarthroides (Fauv.) was taken by Mr. Martin at Berkeley.

Aleocharinae. A number of species have been taken at various times and places by all collectors. None of these have been determined.

Paramedon consanguineum Csy. Taken at Berkeley by Mr. Martin, who records it and the following species as being nearly always present in the nests.

Philonthus nigritulus (Grav.) Taken by Mr. Martin and the writer at Berkeley, in the dung chambers of various houses. This species is found elsewhere, not being peculiar to wood rat houses.

Quedius erythrogaster Mann. This beetle in all stages is a common and characteristic inhabitant of the houses in all localities, and is seldom taken elsewhere. It is found especially in the well-rotted dung of the lower chambers.

Quedius limbifer Horn was taken with the preceding species at Pasadena by Mr. Barrett.

Hesperolinus parcus (Lec.). Taken at Berkeley by Mr. Martin.

Hesperolinus sp. A number of specimens were taken in Santiago Canyon, Orange County, from the well-rotted dung of the lower chambers. This species may prove to be undescribed.

Conosoma castaneum Horn. Taken at Berkeley by Mr. Martin and at Pasadena by Mr. Barrett, in January. It occurs in the well-rotted dung of the lower chambers.

Mycetoporus neotomae Fall. Several specimens were taken in Santiago Canyon, Orange County, in March, in the lower chambers. This species seems to be rather rare, and is probably peculiar to the nests.

Mycetoporus splendidus (Grav.). Taken by Mr. Martin at Berkeley.

Myllaena sp. Taken at Berkeley by Mr. Martin.

Tachyporus californicus Horn was taken by Messrs. Martin and Barrett at Berkeley, and by the writer at Berkeley and in Santiago Canyon, Orange County. This species is not at all common, but a few specimens are usually taken in the course of a season's collecting.

Atheta sp. Two undetermined species of this genus were fairly common in the decomposed dung of the lower chambers of the houses in Santiago Canyon, Orange County, in February.

Atheta occidentalis Bnhr.

Atheta fenyesi Csy.

Baryodma uvidula Csy.

These three species were taken in the houses at Berkeley by Mr. Martin. In addition to the above, seven undetermined species of Staphylinidae were taken by Mr. Martin. I also have several, and among these are probably some that are not included in the above list.

Ptiliidae

Acratrichis horni Matth. This very minute beetle is no overly common at Berkeley. Barrett, in his notes, says "occurs sparingly in many nests during the months of February and March." I once took five specimens from a single nest, but many nests contain none.

Histeridae

Hister foedatus Lec. Occurs sparingly at Berkeley in January and February. One specimen was taken in Santiago Canyon, Orange County, in the rotten dung of the lower chambers.

Gnathoncus communis Mars. Taken by Mr. Martin at Berkeley.

Gnathoncus interceptus (Lec.). Quite common in well rotted dung in the lower chambers during spring at Berkeley (Barrett). Two or three specimens were taken in Santiago Canyon, Orange County, in February.

Dermestidae

Byturus grisescens Jayne. Two specimens taken from nests in Orange County in February. These were probably brought in with food, since the beetle occurs commonly upon the live oak at this season.

Attagenus elongatulus Csy. Several specimens tentatively placed here were taken in Santiago Canyon, Orange County, in February and March of 1930 and 1931. One specimen emerged from a pupa found in the siftings of a nest chamber. This beetle is apparently a regular inhabitant of the wood rat nests, although it may not be confined to them.

Cryptorhopalum sp. One specimen taken at Pasadena by Mr. Barrett was in such poor condition that identification was not possible.

The larva of two species of Dermestidae were taken at Berkeley by Mr. Martin, but attempts to rear them were not successful. The larvae of at least three species were not at all uncommon in many nests in Orange County, but no attempt was made to rear them.

Cryptophagidae

Cryptophagus sp. Taken in small numbers from the lower chambers of nests in Santiago Canyon, Orange County. Also taken by Mr. Martin at Berkeley. He records that this and the following species were found commonly in every nest. They probably feed upon the fungus, which is very thick in the decaying vegetable material of the lower levels.

Atomaria sp. Berkeley (Martin), Orange County; several specimens from masses of dung.

Anchicera nanula Csy. Taken at Berkeley in September by Mr. Barrett.

Mycetophagidae

Litargus balteatus Lec. Taken by Mr. Barrett at Berkeley in the early fall. Of this species he says "it seems to disappear after the first few rains," as do also *Lathridius armatulus* Fall and *Coninomus nodifer* Westw.

Colydiidae

Megataphrus tenuicornis Csy. One specimen taken by Mr. Martin at Berkeley.

Lathridiidae

Metophthalmus rudis Fall. One specimen was taken from a nest chamber in Santiago Canyon, Orange County.

Metophthalmus trux Fall. One specimen was taken at Berkeley by Mr. Martin.

Lathridius armatulus Fall. Taken at Berkeley by Mr. Barrett, as was the following species.

Coninomus nodifer Westw.

Enicmus suspectus Fall. Two specimens were taken from a nest in Santiago Canyon, Orange County.

Enicmus crenatus Lec. Taken at Berkeley by Mr. Martin.

Melanophthalma villosa Zimm. Taken at Berkeley by Mr. Martin, who notes it as being rare.

Melanophthalma distinguenda Com. Same data as the preceding species.

Melanophthalma similiata Gyll. Rare at Berkeley (Martin).

Melanophthalma americana Mann. Two specimens were taken from a nest in Santiago Canyon, Orange County.

Fuchsina occulta Fall. Taken by Mr. Martin in Muir Woods, Marin County. This species occurs in rotten vegetation in other situations. It has been taken by Fuchs by sifting the debris about the bases of redwoods.

None of this family are peculiar to the wood rat houses, but feed upon fungus and decaying vegetable matter, and find conditions in the houses suitable to them.

Coccinellidae

Scymnus pallens Lec. A single specimen of this species was taken from a house in Santiago Canyon, Orange County. It was either brought into the house with food, or was in hibernation there, probably the former.

Alleculidae

Isomira sp. Three specimens were reared from pupae found in the dung of the lower chambers of two houses.

Tenebrionidae

Nyctoporis carinata Lec. Several specimens were taken in Santiago Canyon, Orange County, during February and March. It occurs in numbers in nests about Pasadena in January (Barrett).

Eleodes quadricollis Esch. One specimen taken by Mr. Martin at Berkeley.

Eleodes parvicollis Esch. This species is fairly common at Berkeley, being found in nearly all of the houses.

Coniontis subpubescens Lec. One specimen was taken by Mr. Martin at Berkeley.

Cibdelis blaschkei Mann. Common in all houses in all localities. Newly emerged specimens were found at Berkeley by Mr. Martin, indicating that this species breeds in the houses. It is not peculiar to the houses, however, being found in other places. In Orange County many tenebrionid larvae were found in the houses, some of them of very large size.

Melanryidae

Microscapha californica Barrett. This species was taken in small numbers from nests at Pasadena in January, by Mr. Barrett. He notes it as quite common in the interior of the nests, but hard to capture because of its strong saltatorial powers. A trip was made in January of 1929 to the immediate type locality as described to me by Mr. Barrett, but it was unsuccessful. To all appearances the rats had been poisoned or otherwise killed during the summer of 1928. All of the larger houses had been long abandoned and the smaller ones were too new to contain many insects, having apparently been constructed by recent arrivals to the territory. The rats are sometimes poisoned, as they are regarded as a nuisance and a possible carrier of bubonic plague, and their houses as a fire hazard.

Ptinidae

Ptinus agnatus Fall. One female specimen was taken in Santiago Canyon, Orange County, in February. This beetle may have sought refuge in the house, or may have emerged from one of the dry twigs of which the house was composed.

Scarabaeidae

Aphodius neotomae Fall. This beetle is peculiar to the wood rat houses, never having been taken elsewhere. It is widely distributed, having been taken in Marin County and at Berkeley by Mr. Martin, at Berkeley and Pasadena by Mr. Barrett, and at Berkeley, Pasadena, in Orange County, and near Campo, San Diego County, by the writer. It is present in nearly all of the houses, the larvae being fairly numerous in October and November. The adults are most numerous in January and February.

Aphodius sparsus Lec. This species is also confined to the wood rat houses. It is somewhat more common than *A. neotomae*, and just as widely distributed. The larvae and adults of both these species are found in the moist, rotten dung of the lower chambers of the houses.

Aphodius sparsus Lec. var. *sheldoni* Barrett. Taken in small numbers along with the typical form in nearly all localities in southern California. Described from Carpinteria, Calif.

Aphodius davisi Fall. Several specimens were taken from the dung in the lower chambers of one or two houses in Santiago Canyon, Orange County, on February 2, 1930. A number of other specimens were taken by several collectors at later dates. It is most common in April and May. The species is apparently very local, and is probably confined to the houses of *Neotoma*.

Aphodius vandykei Barrett. A number of specimens were taken in the mountains of Ventura County by Mr. Barrett. It is probable that this species also is confined to the houses of the wood rat.

Aphodius tuberosus Barrett. Taken by Mr. Barrett in Rose Valley of Sespe Canyon, Ventura County.

Curculionidae

Dorytomus luridus (Mann.). One specimen was taken in Santiago Canyon, Orange County. Its presence was in all probability accidental.

Micromastus gracilis (Boh.). Berkeley. Two specimens were taken by Mr. Barrett and myself. Mr. Martin notes that "freshly emerged or immature specimens indicate that it breeds in the nests."

Of the Coleoptera taken by the writer, a few were determined by Dr. E. C. Van Dyke, but the greater number were identified by H. C. Fall.

Lepidoptera

One small moth was taken by Mr. Martin at Berkeley, but was not identified. Numerous larvae were found in many nests in all localities, especially in and about the beds, and presumably feeding upon the dry grass and roots. Attempts to rear these were unsuccessful.

Gander (9) records that "wooly-bear" caterpillars were common in the nests in late spring and summer. At that time of year they are also common under any rubbish on the ground, where they hide to pupate.

Diptera

Gander (9) says that "about fifty per cent of the specimens [of rats] taken in the spring and early summer were carrying one or more of the large grubs or warbles of a species of fly, probably of the genus *Cuterebra*. Many of the autumn specimens were hosts to a small, white dipterous larva resembling that of the common fly, but with two or more short projections on the posterior end."

Anthomyza sp. Reared in small numbers from the refuse sifted from the dung chambers of houses in Santiago Canyon, Orange County.

Pseudatrichia unicolor Coq. Reared in numbers from the same lot of refuse as the preceding.

Trixoscelis frontalis Fall. A small number of specimens were reared from siftings from Santiago Canyon, Orange County.

Parodinia sp. Reared in small numbers from the same lot of siftings as the preceding species.

These flies were determined by F. R. Cole. In addition to the above species, two undetermined species of Geomyzidae and one of Agromyzidae were similarly reared, and are now in the possession of Mr. F. R. Cole.

Siphonaptera

Ceratophyllus sp. One species of the genus is very common at Berkeley, in and about the nest chambers. The other is smaller, and is very numerous in all nests in southern California. It is the presence of these fleas that represents the only real danger in opening wood rat nests. As is the case with the California ground squirrel, these rats are known to be capable of contracting bubonic plague, and their fleas in transmitting it, and the disease is an ever-present threat in California. However, the fleas do not seem to bite persons readily. I have been bitten only three or four times in opening hundreds of nests, the flea population of which ran from a hundred or so to over a thousand individuals per house.

Hystrichopsylla dippiei Roths. This giant flea is not uncommon in the nests at Berkeley. Females may reach a length of nearly one-fourth inch, and are so heavy that they are able to jump only two or three inches. I have never seen this flea in the southern part of the state.

Hymenoptera

Iridomyrmex analis Ern. André. This ant is common in the nests. Two other ants are occasionally met with. On several occasions I have seen ants engaged in carrying off dipterous and coleopterous larvae from the wood rat houses.

Three species of small parasitic wasps were taken by Mr. Martin at Berkeley, one of which he notes as wingless and perhaps peculiar to the wood rat houses. I have taken three species of these little wasps from houses in Orange County and about Pasadena. These are *Anectata californica* Ashm., *Acropiesta* sp. (determined by C. F. W. Muesebeck) and *Phygadeuon* sp. (determined by R. A. Cushman). Whether any of these are the same as those taken by Mr. Martin I do not know. They are probably parasitic upon the larvae of Diptera or Coleoptera in the houses.

Of groups other than the Insecta no special effort was made to collect. The following notes may, however, be of interest:

Arachnida—Numerous specimens of spiders were seen in the houses. No attempt was made to collect these. A small mite is

very numerous in most nests, especially in the beds, in most localities. Harvest spiders are often seen. Pseudoscorpions are very common. One species was taken by Mr. Martin at Berkeley, and what seem to be two species occur commonly in nests in Orange County. They are most common from October to April, each nest then containing several hundred. They are probably scavengers.

Diplopoda—One very large species of milliped is not uncommon in the rat houses about Berkeley. This species reaches a length of about 6 inches. In southern California a kind about 3 inches long is sometimes seen, and one about an inch in length is common.

Chilopoda—Centipedes of various kinds are not at all rare in the houses. No specimens of *Scolopendra heros* were seen, but I always rather expected to be nipped by one sooner or later.

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ADDITIONAL NOTES ON THE EARLY STAGES OF CALIFORNIAN LEPIDOPTERA

By John A. Comstock and Charles M. Dammers

One of our widely distributed Coppers, *Heodes gorgon* Bdv., has thus far eluded all of our western entomologists in their efforts to record its early stages. Mr. and Mrs. Sperry observed the species ovipositing on May 21, 1932, and sent us measurements and descriptions. Later, on May 26, 1932, the junior author obtained numerous examples near Perris, Riverside County, California, and subsequently gravid females were captured which laid readily in captivity. No success was obtained, however, in hatching, and the earlier instars of the larva are therefore still awaiting description.

The eggs are laid singly, or occasionally in pairs or threes, at the forks of the flowering stems of *Eriogonum elongatum* Benth. The time of hatching is probably determined by the rains and consequent condition of the plants. Mature larvae were collected May 9, 1933.

Egg. Echinoid, flattened at the base, with a deep micropyle at the top. The surface is thrown into numerous longitudinal folds averaging about 22 in number. These are connected by lower horizontal partitions. The cells enclosed by these walls are deep, and the junctures of the walls with the main vertical ribs are protruded as irregular tubercles.

Size, .48 mm. high by .84 mm. in diameter. The color is at first a delicate greenish, but later the ridges assume a glistening white, and the general color of the egg is a creamy white. Plate 3 illustrates the egg.

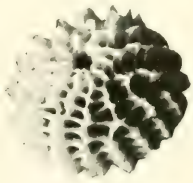

PLATE 3

Egg of *Heodes gorgon*, magnified x 28.

Photo by Menke

Mature larva. 18 mm. long. The shape is of the usual slug type with retractile head. Color of body, a pale turquoise green, largely obscured by a covering of dense long white hairs. This gives the larva a protective coloration harmonizing with the leaves of the foodplant. Spiracles, pale buff. Infrastigmatal fold (overlap) nearly white. Abdomen concolorous with body. Legs, colorless. Prolegs, pale green with light brown claspers. Head, pale buff, with brown mouth parts. See Plate 4.

Pupation takes place late in May, on the foodplant, the chrysalis being supported by a delicate silk girdle.

PLATE 4

Mature larva of *Heodes gorgon*, enlarged x 3½

Drawing by C. M. Dammers

Pupa. Length, 12 to 13 mm. Greatest width through abdomen, 4.75 to 5 mm. Color pale blue-green, with a slight yellowish shading on the body. The head, thorax and all abdominal segments are thickly studded with minute fungoid or trumpet-shaped white protrusions. Spiracles, buff. There is an indistinct mid-dorsal dark line, caused by the obsolescence of the fungoid protrusions, and there are also four longitudinal rows of circular patches, caused by the same absence of the white protrusions. The thorax and wing cases are covered with patches of whitish powdery scale. These, on the wing cases, are so arranged as to indistinctly define the venation. Cremasteric hooks, minute, and light brown. The chrysalis is illustrated on Plate 5.

The imagos emerged from June 12th on.

Our thanks are due to Mr. Theodore Childs of Riverside for first calling our attention to the foodplant of the species.

a. *b.* *c.*

PLATE 5

Pupa of *Heodes gorgon*, enlarged x 4.

a. Dorsal aspect. *b.* Lateral aspect. *c.* Ventral aspect.

Photo by Menke

PHILOTES BATTOIDES BERNARDINO B. & McD.

Described from eggs laid in captivity, and from larvae in all instars collected at Lee Lake, Riverside Co., Calif., July 9, 1933, on the flowers of *Eriogonum fasciculatum* Benth.

EGG. Of the usual echinoid shape and character. Color, bluish white. The eggs are laid singly on the flowers of *Eriogonum*, and the larvae feed exclusively on the blossoms.

LARVA, first instar. Color of body, yellowish white; head black. A few long colorless hairs arise from each segment. These are recurved posteriorly.

Successive instars. Slug-shaped. The color is variable ranging from a yellowish green to a pale blue-green. There is a slightly darker mid-dorsal narrow band. Overlap, white. Legs colorless, with brown tips. Prolegs concolorous with body. Head, black. Spiracles, soiled white. Abdomen concolorous with body.

The entire body is sparingly covered with minute pale brown punctae; also there is a complete covering of short white hairs, except on the head.

A few of the larvae assumed the color pattern of the mature caterpillar when in their third instar, but the majority were marked as above described until their penultimate instar.

Mature larva. Length extended, 11 mm.

There is a great variation in color and pattern, ranging from a uniform pale blue-green, through green with chocolate markings, lemon yellow with chocolate, pale soiled yellow, to a uniform pink. The form here described is that with pale green body color and rich chocolate pattern.

Body color, green. There is a broken mid-dorsal band of chocolate, and laterally a broad diagonal chocolate band, formed in spear-shaped patches on each segment, as shown in Plate 6.

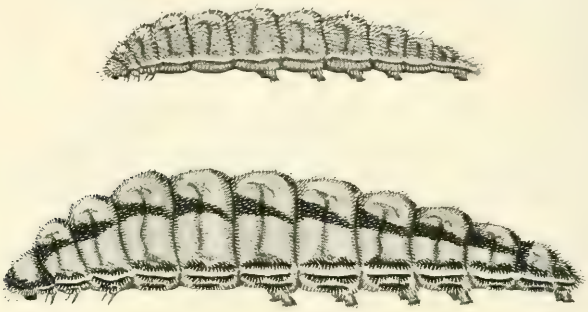

PLATE 6

Larva of *Philotes battoides bernardino.*

Upper figure, intermediate instar. Lower figure, mature larva x 7.

Drawing by C. M. Dammers

Overlap, white, edged above and below with chocolate. At the junction of all legs with the body there is a broad, chocolate patch. Abdomen, pale greenish white.

Spiracles, soiled white. Legs, colorless, with brown tips.

Prolegs, greenish white, the claspers brown.

Head, jet black, and retractile.

The entire larva, except the head, is covered with a fine silvery white pile. Three larval stages are illustrated on Plate 6.

Pupation took place late in July, apparently without any silken attachment, in the dessicating blossoms of the *Eriogonum.*

PUPA. Length, 5 to 7 mm. Color, pale chestnut, with a slight suggestion of green on the wing cases.

Stigmata, dark chocolate. There are no hairs or appendages on any portion of the pupa. See Plate 7.

The larvae are parasitized by a minute Ichneumonid.

This species is single brooded, the imagos emerging from late May to July.

a.

b. *c.*

PLATE 7

Pupa of *Philotes battoides bernardino.*

a. Lateral view, enlarged x 7.
Drawing by C. M. Dammers

b. Ventral view x 6. *c.* Dorsal view x 6.
Photo by Menke

CHLOROCHLAMYS CHLOROLEUCARIA Guen.

The larva and pupa of this species were briefly described in 1879 by Hulst,[1] and in somewhat greater detail by L. W. Godell[2] in 1880.

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[1] Geo. D. Hulst. Bull. Brooklyn Entom. Soc. Vol. 2, p. 78.
[2] L. W. Goodell. Canad. Entom. Vol. 12, p. 235.

No illustrations of the mature larva and pupa have been published to our knowledge, and the accompanying cuts, Plates 8 and 9, will therefore be of some aid to entomologists.

The foodplant on which our examples were taken was *Eriogonum fasciculatum* Benth., which constitutes a new record. The species has previously been recorded on *Helianthus, Aster, Eupatorium* and *Achillea.*

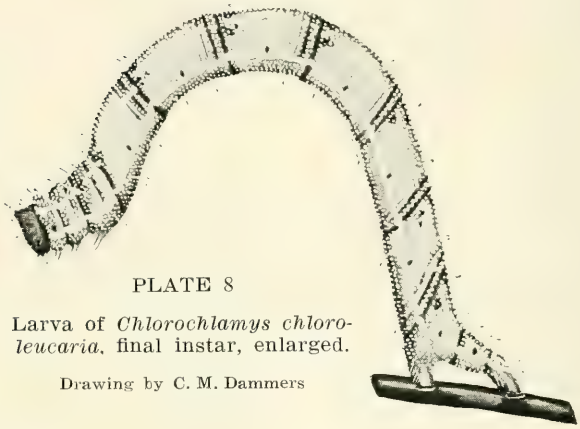


PLATE 8

Larva of *Chlorochlamys chloroleucaria*, final instar, enlarged.

Drawing by C. M. Dammers

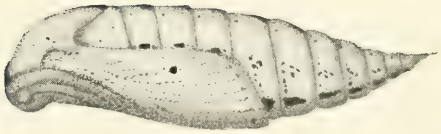


PLATE 9

Pupa of *Chlorochlamys chloroleucaria*, lateral aspect, enlarged.

Drawing by C. M. Dammers

Hesperumia sulphuraria Pack.

A single larva of this species was collected at Pine Knot in the San Bernardino Mts. on June 10, 1933, feeding on an unknown bush. It was raised to maturity on rose.

Additional examples were secured on June 17th of the same year, feeding on *Ceanothus cuneatus* Nutt., in Bouquet Canyon. The larva is of the usual geometrid type, and is camouflaged to resemble the twigs of *Ceanothus*.

Mature larva. Length, 32 mm. The ground color ranges through gray and mauve to a greenish yellow. It is striped longitudinally with irregular fine lines of dark mauve to brownish black, and the pattern is broken with numerous spots and dashes. These markings are well brought out in the accompanying cut, Plate 10. There are a number of minute brownish black tubercles scattered over the surface, each of which is topped with a light brown to black hair. A few barnacle-like tubercles are disposed as shown in the drawing. A pair of these on the fifth segment are connected by a dark mauve band over the dorsum. The lower half of the ninth segment is heavily mottled with mauve and white.

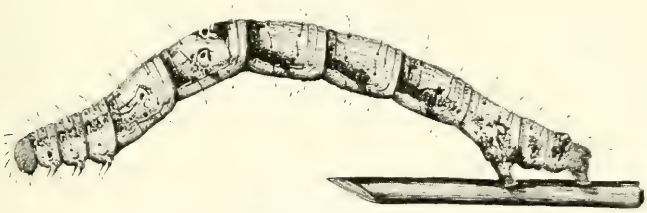


PLATE 10

Larva of *Hesperumia sulphuraria*, final instar, enlarged x 2½.

Drawing by C. M. Dammers

The infrastigmatal fold is indistinct, and of a gray or greenish yellow color. Spiracles, orange-brown, black rimmed. Abdomen concolorous with body.

Legs, orange-red to brown. Prolegs dark mauve, the front pair blotched with white. Head, pale mauve, heavily spotted with dark greenish mauve. Spinnarets, light mauve. Mouth parts, dark brown. Ocelli, brown. A few short colorless hairs are scattered over the head. Other markings not specifically mentioned are clearly shown in the drawing.

One example pupated in the bottom of the breeding cage without any evidence of a cocoon. Others used a loosely woven silk covering. The specimen from Pine Knot pupated July 7th, and the imago emerged July 24th.

Pupa. Length, 12 to 14 mm. The color is a uniform chestnut, and the surface is minutely pitted and irrorated. On some examples there is a slight shading of green over the wing cases. A few short colorless hairs arise from the thorax and head. Cremasteric hooks, four in number, one pair being very short. The pupa is illustrated on Plate 11, making further description unnecessary.

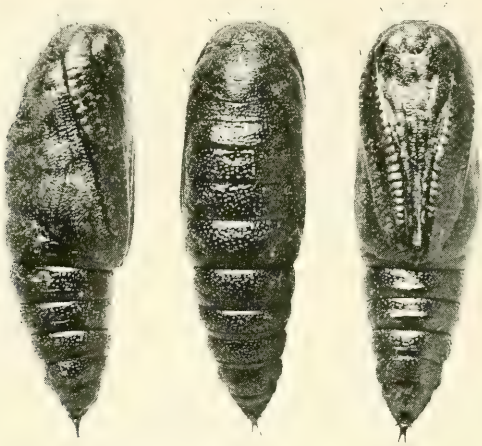


PLATE 11

Pupa of *Hesperumia sulphuraria*, enlarged x 5.

Photo by Menke

Sicya snoviaria Hlst.

This species was reared from a single larva collected at Riverside, Calif., July 5, 1933, on mistletoe.

Mature larva, length, 16 mm.

Body color, apple green, heavily overlaid with crinkled white lines and spots which are edged with greyish red. There is an indistinct narrow mauve mid-dorsal band. Segmental joints, yellowish. A lemon-yellow patch occurs mid-dorsally on the tail segment. Spiracles, yellow, with black rims. The infrastigmatal fold is white, but is nearly obscured by the pattern. It is more clearly distinguishable in the region of the prolegs. Abdomen, concolorous with body. Legs, apple green with colorless points. Prolegs yellowish green, speckled with brown.

Head, apple green, and bearing a few short colorless hairs. Mouth parts, brown. Ocelli, black on a white patch.

On each side of each body segment there are three pairs of colorless hairs of medium length, arranged diagonally. Plate 12 illustrates the larva.

Pupation took place July 19, 1933, on the foodplant. A light silken cocoon is formed in a covering of leaves.

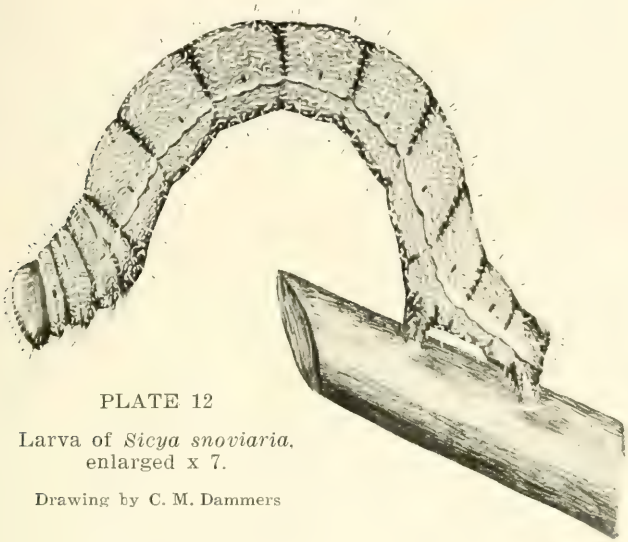


PLATE 12

Larva of *Sicya snoviaria*, enlarged x 7.

Drawing by C. M. Dammers

PUPA. Length, 13 mm.

Color, pale green, with a silvery lustre, making it a difficult object to illustrate in water color. The segmental joints are blotched with circular white patches. Spiracles, brown. A few brown hairs occur on the head and thorax. The form is correctly shown on Plate 13. Emergence of the imago occurred July 31, 1933.

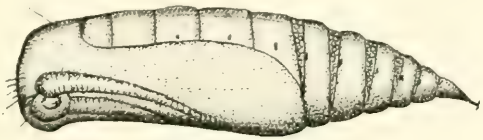


PLATE 13

Pupa of *Sicya snoviaria*, enlarged x 4½.

Drawing by C. M. Dammers

Through the courtesy of Mr. Ernest L. Bell in submitting an analysis of the distinguishing features of *Thorybes mexicana* H. S. and *Thorybes diversus* Bell we are able to definitely state that our published life history on *T. mexicana* (Bulletin So. Calif. Acad. of Sciences, Vol. 32, p. 110, 1933) should refer to *T. diversus*.

It is safe to conclude that *T. mexicana* should be removed from our California lists. Its range is far south of our borders. Possibly it may occur as a straggler from Mexico, along the southern edge of Arizona.

Apodemia mormo deserti B. & McD.

Eggs of this subspecies were collected March 11, 1933, on the Palms to Pines highway, Riverside County, Calif. They were laid on *Eriogonum inflatum* Torr. & Frem.

The egg, larva and pupa are indistinguishable from those of *A. mormo virgulti* Behr.

STUDIES IN PACIFIC COAST LEPIDOPTERA
(Continued)

By John A. Comstock
Associate Director, Los Angeles Museum

Argynnis macaria Edw.

The larva and pupa of this species were described and illustrated in 1931[1] but at that time no notes were given on the egg.

Females were induced to lay in captivity this past summer, and the following notes will help to complete our knowledge of the life history of this species.

Egg. Size, 1 mm. tall by .75 mm. wide. Color, straw to brownish pink.

The form is sub-conoidal, but is more robust than with most fritillaries.There are approximately 30 longitudinal ridges, and the usual series of small transverse partitions connecting these.

Plate 14 accurately pictures this egg.

PLATE 14

Egg of *Argyanis macaria*, enlarged x 30.

[1]Bulletin So. Calif. Acad. of Sciences, Vol. 30, part 2, pp. 40-41.

MELITAEA CHARA Edw.

The metamorphosis of this butterfly was recorded in 1929* but at that time a drawing of the mature larva was not available.

We are publishing on Plate 15 the final instar of this larva, which will serve to complete our record of this metamorphosis.

PLATE 15

Mature larva of *Melitaea chara*, enlarged.

Drawing by J. A. Comstock

PHILTRAEA ELEGANTARIA Hy. Edw.

The types of this moth were taken at Tucson, Arizona. The species is not common, particularly in California. It is, however, rather widely distributed, ranging as far east as Tennessee.

On June 17, 1933 while beating *Ceanothus* bushes in Bouquet Canyon for larva, a single chrysalis was secured, which, on June 23, gave forth an imago. This proved to be a female, and fortunately produced a few eggs while on the setting block. These were, of course, infertile, and it was therefore impossible to record the larva.

EGG. Size, .75 mm. tall x .5 mm. thick. Color, opaque light green. In form it is sub-ovoid, with a rounded base and strongly cupped top. The surface is smooth, except for the micropylar end, which is finely granular. See Plate 16.

PLATE 16

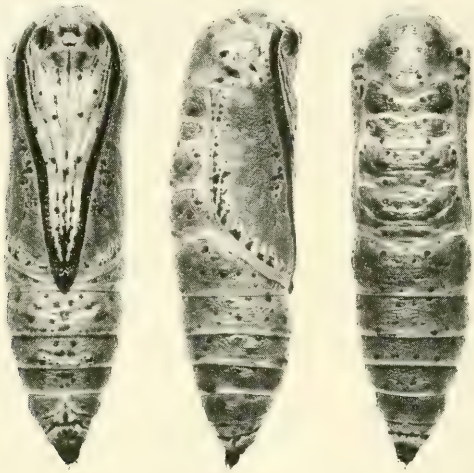
Egg of *Philtraea elegantaria*.
enlarged x 36

Drawing by J. A. Comstock

* Bulletin So. Calif. Acad. of Sciences, Vol. 28, part 3, pp. 50-52.

Pupa. Length, 13 mm. Greatest width through 3rd abdominal segment, 3.2 mm. Color, lemon-yellow, with numerous black markings, disposed as shown in the illustration. Antennal cases black.

The accompanying cut, Plate 17, renders a further description unnecessary.



a. *b.* *c.*

PLATE 17

Pupa of *Philtraea elegantaria*, enlarged x 4½.

a. Ventral aspect. *b.* Lateral aspect. *c.* Dorsal aspect.

Photo by Menke

Sabulodes cervinaria Pack.

Larvae of this species were secured on June 10, 1933 while beating oak *(Quercus)* on the Ridge Route near Lebec, Calif.

Mature Larva. Length, 32 mm. Ground color, gray, heavily irrorated with dark brownish black broken lines.

The form is of the usual cylindrical geometrid type, with two pairs of prominent prolegs.

The head is flattened, and is a light gray, with minute brown spots. It is sparingly covered with minute colorless pile. On

the cheek, just above the ocelli there is a horizontal whitish band, edged above with a wider blackish band and the latter edged superiorly with a narrow light band. Ocelli, brown. There are two quadrate black spots on the cheeks, one to each side.

The first segment is restricted; the second is wide, and has on its shoulder a black spot which extends forward onto the first segment.

On the posterior edge of the 7th and 8th segments there are paired protrusions, one on each side of the median line. These are tipped with brownish black.

Legs, proleg and anal proleg gray, with blackish spots and broken lines.

Stigmata, light brown, with narrow black rims.

Other markings and characteristic protrusions not specifically mentioned are clearly shown in the accompanying cut, Plate 18.

PLATE 18

Larva of *Sabulodes cervinaria*, enlarged x 2½.

Photo by Menke

Pupa. Length, 15.2 mm. Greatest width, 4.5 mm. through 3rd abdominal segment.

Color, wood-brown, the abdominal segments red-brown. There is a peculiar keel-shaped protrusion over the crest of the head in the median line.

A median longitudinal row of black spots occurs on the dorsum, starting on the 2nd abdominal segment. Only a single spot occurs on each segment in this line.

A few minute black punctae occur over the body at various points, as shown in our illustration, Plate 19. The last caudal segment and cremaster are black. Together they form a helmet-like termination from the crest of which protrudes a number of fine cremasteric hooks.

Stigmata, black and prominent.

There are no hairs or vibrissae on any portion of the chrysalis.

Pupation occurred on the floor of the breeding jar, with a meagre amount of loosely woven silk.

The imago emerged Sept. 27, 1933.

a. *b.* *c.*

PLATE 19

Pupa of *Sabulodes cervinaria*, enlarged x 3½.

Photo by Menke

THE CAPTURE AND STINGING OF THE PREY OF SPHEX XANTHOPTERUS (CAM.)

By Charles H. Hicks, University of Colorado

The capture and subsequent stinging of the prey by a wasp constitutes one of the most interesting series of its activities. This interest may be greatly accentuated by the apparent difficulty of finding the wasp at the opportune time. Usually, it would seem, the capture involves the huntress in no small degree of difficulty and toil. It requires patience and perseverance on the part of the observer to witness it but success well repays the time and effort spent.

The digger wasp, *Sphex xanthopterus* (Cam.),* has been found common along the Los Angeles River, at and near Los Angeles, California. This wasp, in contrast to many other species belonging to the genus which select nesting sites in dry soil, appears to prefer the lower, damp sands of the river banks and bed as a place in which to dig its nest. It was at such a spot near the First National Studios at Burbank that the wasp was seen to capture her prey in September 1928. The very warm days of September and of October, often among the hottest of the year at Los Angeles, are very suitable to the nesting activities of this insect. We shall now follow her on one of her many hunting expeditions.

The wasp was found (9:20 A. M. on September 16) searching over a rather limited area, walking erratically about in accordance with her custom and giving an occasional flip with her wings. She seemed to lift them rather rapidly and somewhat periodically, but not so high as *Podalonia violaceipennis* nor so actively as some Spider wasps. She was easily observed, apparently being very intent upon her work. Thus by remaining as nearly motionless as possible, her every move could be detected as she thoroughly investigated the territory, even searching on and about my shoes. It could be seen, at this close range, that she frequently tapped the surface of the sands with her antennae in her hunt for prey.

At intervals of about seven minutes, she rested for a few seconds flat on the surface and quietly, almost motionless, except for a feeble waving of her antennae. Once while thus inactive, a male alighted upon her. There was heard almost immediately a loud buzzing, the male flew away while the female resumed her work as though not having been disconcerted in the least by the incident. She soon came upon three pellets of excrement, apparently those from a lepidopterous larva. She tapped each many times with her antennae, and somewhat excitedly, as though she might have "smelled" a moth larva.

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* Kindly determined by Professor H. T. Fernald.

During a period lasting twenty-six minutes, *S. xanthopterus* confined her hunting mainly to the open and where now and then a single plant could be found. At the end of this time, she arrived at some low growing, sweet clover plants (probably *Melilotus indica* All.). Here she began to search, especially on the ground beneath the stems, although she sometimes climbed over them. A few times she gave particular attention to specific areas where the sandy soil appeared recently to have been disturbed. She even grasped old stems and dead leaves, removing them or looking beneath them. At these times she appeared excited, working much more rapidly than at others. Not locating a larva, or finding herself in error, she would continue a steady, monotonous search elsewhere.

After this barren stay among the sweet clover plants, the wasp again moved out into the open, into the region where she was first observed and in which she had spent so much time. Here, after fifteen feet of travel, she suddenly located a larva at the edge of a very inconspicuous plant, a stunted *Epilobium* sp., now dry and brown and nearly dead.

She threw herself upon the larva, grasping it back of the head with a dorsal hold. Then quickly curving her abdomen beneath her, she stung it on the first abdominal segment on the ventral side. She next proceeded anteriorly, carefully feeling with the tip of her abdomen and stinging it successively three times more, each on the ventral side between a pair of true legs. The order then, of this first series of stings was: first abdominal; third thoracic; second thoracic; and first thoracic segment. After the fourth sting the prey was released, the wasp walked a few inches away and carefully brushed her body with her legs. The larva, meanwhile, was not able to move away since it had been rendered helpless by the stinging.

The wasp remained away engaged in this activity for a few seconds and upon returning to the prey, pinched it with her mandibles from head to tail, apparently testing its reactions. In pinching the larva, the wasp took neither a ventral nor a dorsal hold but grasped it as it lay on its side. It responded by twitching its body feebly, whereupon the wasp grasped it at the back, just posterior to the center of its body. Moving the sting along the ventral side of her victim until she reached the segment just behind the head, she carefully inserted her sting between the first pair of true legs. After leaving it within for a few seconds she removed her weapon, released the unfortunate creature, and walked away to brush herself again. This time, however, her activity was much shorter than it had been before.

Returning, she grasped the prey in her jaws, in the usual or normal manner followed by many species, belonging to the genus *Sphex* and *Podalonia,* in stinging their prey; that is, back of the head on the dorsal side of the body. She proceeded to sting it three times more, posteriorly to and including the first

abdominal segment, which had been the first of all in this instance to be stung. The last or eighth sting found a helpless and limp larva which hardly moved at all when released by the wasp to again brush herself.

In a final return to the prey, after a brief rest, she grasped it in the normal position for carrying it away. But instead of moving it, she began to malaxate it. She squeezed it or pinched it lightly a number of times just back of the head and began lapping with her mouth parts the fluid which collected at the mouth of the prey. During the latter part of this feeding, when she did not pinch its "throat" but merely fed on the juices, she remained very quietly with her abdomen in line with her thorax and head, and with her wings flat against the dorsal region of her body.

Then after rapidly pinching the segments, she picked up the larva quickly and rather carelessly, carried it two inches away and released it. She then and there deserted the prey, apparently having no further use for it. She walked a few inches away, flew ten or twelve feet farther in a number of short flights, then entirely out of sight in the direction of some large white, sweet clover plants. She had forsaken the larva, where it remained openly on the ground, and that after no circling about in the manner of a locality study, upon leaving. The abandoned prey was watched constantly for over an hour, during which time the wasp did not return; in fact, she was not seen during this period. Late in the day the larva still remained where it had been left by the wasp. It was then secured for further study and taken to the laboratory.

Other captures have been witnessed. One involved the stinging of the prey fifteen observed times and with a probability of three or four additional. This large number is apparently unusual and seemed to have been caused by an exciting element in the environment; in this instance, a small lizard which almost succeeded in wresting the prey from the wasp. There is, however, a variation in the number of times a given prey may be stung, the number depending, in part at least, upon the nature of the individual wasp and upon the resistance and reactions of the prey. Occasionally, a wasp malaxates a stung larva. Likewise one may be rejected and not be stored for the young, but usually the captive is taken to a nest and serves the sole food for the subsequent growth and development of the waspling. The adult female often captures the larvae of *Zale lunata* (Drury) or its varieties*, but she may use moth larvae of other species found in her nesting territory.

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*An account of the prey and the nesting habits of the wasp may be found in the Canadian Entomologist. vol. LXIV. pp. 193-198. 1932.

A REVISION OF THE HEUCHERA RUBESCENS GROUP (SAXIFRAGACEAE) FOR THE UNITED STATES

By Margaret G. Stewart

The southwestern species of the genus Heuchera placed by Rydberg (No. Amer. Flora *22*:99. 1905) in his "Rubescentes" have been the source of much difficulty to botanists. My attention was directed to the study of this group by Dr. Philip A. Munz of Pomona College, under whose direction this paper has been prepared and to whom I express my appreciation. I wish also to thank the officers in charge of the following herbaria for kindly lending me the material which has been used in the preparation of this paper. The abbreviations indicated below are used in citing material.

Dudley Herbarium of Stanford University .....(S)
Herbarium of F. W. Peirson of Pasadena .....(FP)
New York Botanical Garden .....(NY)
Pomona College Herbarium .....(P)
United States National Herbarium .....(US)

My gratitude is due also to Dr. Aven Nelson of the University of Wyoming for the loan of the type of *H. Clutei,* to Mrs. Elizabeth Crow Norland of the University of California for bibliographical work, and to C. A. Weatherby of Gray Herbarium for information concerning the type of var. *nana.*

Since it has been impossible to delimit clearly the various entities which this paper proposes to recognize, intergradation being found between almost all these entities, it has seemed best to include them all as varieties of one polymorphic species. None of them can be separated from typical *H. rubescens* with at all the same distinctness as can *H. sanguinea, H. micrantha,* etc., which have long been recognized as separate species.

Of the various characters which have been used in an attempt to separate entities that have been proposed and those that are here recognized, only a few have been found of any use. Such are petal width and shape, shape of hypanthium, base of leaf-blades, and pubescence on petioles and hypanthium. Such characters as size and general shape and pubescence of the leaf-blades, length of petioles, and type of inflorescence have proved useless. The distribution of this group is quite wide, extending from Oregon to Lower California, Utah, Texas, and northern Mexico. For the most part the varieties here recognized have quite distinct and limited geographical distribution, the most notable exception being var. *glandulosa,* which ranges from the Sierra Nevada of California to Lower California, Texas and Chihuahua.

DESCRIPTION OF SPECIES

Heuchera rubescens Torr., in Stansb. Expl. Utah, 388. 1852.

Acaulescent perennials with stout, scaly rootstocks; plants rather small, less than 4 dm. high, the stem of the scape usually glabrous or rarely puberulent; inflorescence paniculate, secund; leaves mostly basal, cordate, reniform, or truncate, the lobes shallow and bristle-tipped, the petioles glabrous to hirsute, 1 to 10 cm. long, the blades 1-3 (5) cm. wide; hypanthium campanulate or cylindric, including the sepals 3-8 mm. long, pilose, puberulent or glandular; calyx reddish or purplish, the lobes greenish-tipped; petals linear-oblanceolate, oblanceolate or spatulate; stamens equal to or exceeding the calyx lobes.

KEY TO VARIETIES

Petals narrow, not more than 0.5 mm. wide.

Hypanthium campanulate, 3-5 mm. long, including the sepals.

Petioles glabrous.

Leaves cordate .....1. *H. r.* var. *typica.*

Leaves truncate or cuneate .....2. *H. r.* var. *cuneata.*

Petioles hairy.

Leaves cordate .....3. *H. r.* var. *glandulosa*

Leaves truncate .....4. *H. r.* var. *oregonensis*

Hypanthium cylindric, 5-6 mm. long, including the sepals. 5. *H. r.* var. *versicolor.*

Petals broad, from 0.5-1.5 mm. wide.

Hypanthium pilose as well as puberulent.

Petals 4 times as long as wide. San Gabriel Mts..... .....6. *H. r.* var. *elegans.*

Petals 6 times as long as wide. San Bernardino and San Jacinto Mts. .....7. *H. r.* var. *Parishii.*

Hypanthium with almost no longer hairs, glandular-puberulent only.

Hypanthium cylindric; stamens 3.5-4 mm. long. San Gabriel and San Bernardino Mts.....8. *H. r.* var. *Abramsii.*

Hypanthium campanulate; stamens 3 mm. long. Tehachapi Mts. .....9. *H. r.* var. *caespitosa.*

TREATMENT OF VARIETIES

1. H. rubescens Torr. var. typica n. nom.

H. rubescens Torr., in Stansb. Expl. Utah, 388. 1852.

Petioles glabrous; leaf-blades reniform or cordate; hypanthium campanulate, including the sepals about 5 mm. long, glandular-puberulent and pilose above; petals 4 mm. long, 8 to 12 times as long as wide; stamens 4.5 mm. long.

Type locality, Summit of mountain, Stansbury's Island, Utah. Ranging throughout Utah into northern New Mexico and Arizona and into eastern Nevada. Material examined: UTAH: without

locality, *Parry 12* (NY, US); Stansbury's Island, *Stansbury Exped. in 1850,* type (NY); Marysvale, *Jones 5901* (P, US); Beaver City, *Palmer 149* (NY, US); Moab, *Jones in 1891* (P); Mts. north of Bullion Creek, *Rydberg and Carlton 7063* (NY); Hills near Thistle Jct., *Stokes in 1900* (NY, S, US); Wahsatch Mts., *Watson 366* (NY); Provo, *Goodding 1126* (NY, P, US); City Creek Canyon, *Jones 1457* (NY, P, US); Pine Valley Peak, *Purpus 6211* (P, US).——NEVADA: Ruby Mts., *Heller 11101* (S); Humboldt Mts., *Watson 366* (US); Glencoe, *Jones in 1891* (P); Star Peak, *Jones in 1901* (P).——ARIZONA: Buckskin Mts., *Jones 6052h* (P); Mt. Agassiz, *Rusby in 1883* (NY, P, US); San Francisco Mts., *Knowlton 100* (US).——NEW MEXICO: Brazos Canyon, Rio Arriba Co., *Standley and Bollman 10649* (US); Ute Park, Colfax Co., *Standley 13720* (US).

In general, *typica* is distinguished by its smooth petioles and its range. Occasionally material from far outside the normal range cannot be distinguished from *typica,* but has glabrous petioles, for example: *Congdon in 1897,* from Mariposa Co., Calif. (S); a *Brandegee* specimen from Yosemite (S); *Jones in 1900,* from Summit, Sierra Nevada, Calif. (US); and *Rusby 2457,* from the Bill Williams Mts., Ariz. (US).

✓ 2. H. rubescens Torr. var. cuneata (Howell) n. comb.
H. cuneata Howell, Fl. N. W. Am., 203. 1898. *H. rubescens* var. *oregonensis* Wheelock, Bull. Torrey Club 17: 197. 1890, in part.

Petioles glabrous; leaf-blades truncate or cuneate; hypanthium campanulate, including the sepals 4-5 mm. long, glandular-puberulent and somewhat pilose above; petals 3.5-4 mm. long, about 7 times as long as wide; stamens 3, rarely 4 mm. long.

Type locality, Harney Valley, Steins Mt., eastern Oregon. Growing only in Stein's Mts., eastern Oregon. Material examined: Stein's Mt., *Howell in 1885* (NY), *Leiberg 2400* (NY, P), *Cusick 1260* (US), *1993* (S).

Wheelock gives three stations for his var. *oregonensis* (Steins Mt., Harney Valley, and Siskiyou Mts.), but cites only one specimen, namely *Howell 689* from Siskiyou Mts., Oregon. Since it is the only specimen cited, it would seem logical to take *Howell 689* as the type of *oregonensis.* I have not seen this type, but coming from southwestern Oregon, it is almost certain to be *Pringlei* which differs from the plants of eastern Oregon chiefly in the presence of hairs on the petioles, a character not mentioned by Wheelock. Since this uncertainty is attached to the name *oregonensis* it seems best to use, as a varietal name, *cuneata* of Howell which was proposed for plants from Harney Valley, eastern Oregon. Howell gives no definite type for his *cuneata,* but states that it comes from "dry cliffs, Harney Valley eastern Oregon." The only Howell collection I have seen is from Stein's

Mountain, May 28, 1885, of which there are four sheets at New York Botanical Garden, one of these has had "no. 811" written on it.

Cuneata differs from *typica* in the base of its leaf-blades, and material from northern Nevada is quite intermediate between the two. A specimen from Star Peak, *Jones in 1901* (P) and one from Ruby Mts., *Heller 11101* (S) seem to be intergrades of this sort.

✓ 3. H. rubescens Torr. var. glandulosa Kellogg, Proc. Calif. Acad. ser. I, 5:45. 1873.
H. rubescens Torr. var., Gray, Pl. Wright. 2:64. 1853. *H. lithophila* Heller, Muhlenbergia 1:105. 1904. *H. pachypoda* Greene, Leaflets Bot. Observ. 1:111. 1905. *H. nana* Rydb., N. Am. Fl. 22:111. 1905. *H. Sitgreavesii* Rydb., l. c. *H. pulchella* Wooton and Standley, Contrib. U. S. Nat. Herb. 16:130. 1913. *H. Clutei* Nels., Am. Bot. 28: 22, 1922. *H. rubescens* var. *nana* Wheelock, Bull. Torr. Club 17:197. 1890.

Petioles hairy; leaf-blades reniform or cordate; hypanthium campanulate, including the sepals 3.5-5 mm. long, glandular-puberulent, abundantly or sparingly pilose; petals 5 mm. long, about 10 times as long as wide; stamens 5 mm. long.

Type locality, Stanford Peak, C. P. R. R., at an altitude of 10,000 ft., California. Ranging from the Sierra Nevada and White Mts. of California to northern Lower California and east to Texas and Chihuahua. Material examined: CALIFORNIA: Near Summit Station (Donner Pass), *Heller 7028*, type collection of H. *lithophila* (P, S, US); Summit, *Kellogg in 1870* (S), *Jones in 1902* (P); Soda Springs, *Jones 2510* (P, S, US); White Mts., *Duran 539* (NY, P); Vernal Falls, *Abrams 4594* (NY, S); Fallen Leaf Trail, *Abrams 4823* (P, S); Lone Pine, *Jones in 1897*, type collection of *pachypoda* (P, US); Langley's Camp, Mt. Whitney, *Hall and Babcock 5549* (S); Mt. Silliman, *Palmer, Coville, and Funston 2093* (US); Near Mineral King, *Coville and Funston 1488* (S, US); Idlewild, *Miller in 1921* (US); Cuyamaca Mts., *Abrams 3951* (P, S).————NEVADA: Charleston Mtn., *Hitchcock in 1927* (P), *Goodman and Hitchcock 1690* (S, NY), *Heller 11025* (S, US).————ARIZONA: Without locality, *McDougal 135* (NY, US); Bill Williams Mtn., *Rusby in 1909* (NY); Mt. Graham, *Peebles, Harrison and Kearney 4447* (US); "Rim Rock," Tonto Basin, *Mearns 138* (NY); Near the Summit, Hidden Spring, Navajo Mt., *Clute 80*, type of *Clutei* (University of Wyoming).————NEW MEXICO: Without locality, *Wright 1097* (NY), *Wright in 1851* (NY); Camp 19, *in 1851*, type of *H. Sitgreavsii* Rydb. (NY); Santa Rita, *Bigelow 406a* (NY); Mogollon Mts., *Metcalfe 512* (NY, US); Sandia Mountains, *Wooton in 1910*, type of *H. pulchella*, (US). ————TEXAS: Chisos Mts. near summit, *Havard 39* (US).

s. w. of Boot Spring, *Moore and Steyermark 3185* (NY), Summit Lost Mine Peak, *Ferris and Duncan 2863* (NY, S); Davis Mts., Livermore Peak, *Ferris and Duncan 2546* (NY, S), Mt. Livermore, *Palmer 34369* (NY).————MEXICO: Vallecitos, (Lower Calif.), *Goldman 1234* (US); Chihuahua, near Colonia Garcia, *Townsend and Barber 189* (US), *Nelson 6145* (US).

An examination of Gray's discussion (Pl. Wright. 2:64. 1853) shows that he did not there publish a var. *nana,* but his use of the word "nana" was as a descriptive term and not as a name. The type used for the word nana is the same as for the rest of descriptive phrase "nana; scapo subspithamaeo; floribus parvulis" and is different from that used for "H. rubescens." Furthermore "H. rubescens, Torr." is followed by a semicolon; then begins "var. nana, etc." Mr. C. A. Weatherby of the Gray Herbarium has kindly looked into the matter and agrees with me that Gray did not intend to name the variety which he discussed. Moreover, Mr. Weatherby found no sheet at the Gray Herbarium labelled "var. nana" by Dr. Gray. It is evident, therefore, that the use of the name "nana" is based on a misapprehension. A search through the literature between the years 1853, the date of Gray's Pl. Wright., and 1873 that of the publication of Kellogg's var. *glandulosa* has failed to reveal the use of the name *nana* for the variety.

Specimens from the San Francisco Mts. show intergradation with var. *typica* in a tendency towards glabrous petioles. Such sheets are, San Francisco Mt., *Wolf 3118* (S), *Cannon and Lloyd in 1904* (NY), Humphrey's Peak, *McDougal 410a* (US, NY).

4. *H. rubescens* Torr. var. *oregonensis* Wheelock, Bull. Torrey Club 17:197. 1890.

H. Pringlei Rydb., N. A. Fl. 22:111. 1905. *H. rubescens* var. *Pringlei* (Rydb.) Jeps., Man. Fl. Pls. Calif., 463, 1925.

Petioles sparingly hairy; leaf-blades truncate or cuneate; hypanthium short, campanulate, including the sepals 3-4 mm. long, glandular-puberulent and short hairy, especially above; petals 3-3.25 mm. long, about 6 times as long as wide; stamens 3-4 mm. long.

Type locality, Siskiyou Mts., Oregon. Known from Siskiyou and Trinity Counties, California, along the western slope of the Sierra Nevada to Tulare and Fresno Counties, and from the San Bernardino Mts. Material examined: Without locality, *Brewer 1860-67* (US); Siskiyou Co., Mt. Eddy, *Heller in 1914* (NY, S), Castle Lake, fragment of type of *Pringlei* (NY); Yosemite Valley, *Abrams 4602* (NY, S), *Bolander 4935* (US); Eagle Peak, *Hall 9195* (US); Vernal Falls, *Abrams 4594* (P, S); Ledge Trail, *Chandler and Babcock 315* (NY, P, S, US); Long Lake, Plumas Co., *Bacigalupi 1687* (S, P); Rock Creek

Lake Basin, *Peirson 9462* (FP); South Lake, Bishop Creek, *Peirson 8518* (FP); South Fk. of San Joaquin River, *Hall and Chandler 622* (US); Bear Valley, *Parish 1820* (S); Bluff Lake, *Johnston in 1924* (FP, P).

Oregonensis is at most an uncertain entity not clearly distinct from *nana* and occurring with the latter in the western Sierra Nevada. Its chief character seems to be the truncate or cuneate leaf-base. Some collections are quite intermediate, such as *Hall and Babcock 5308* from Volcano Creek, Upper Kern River (S) and *Brewer 1759* from head of Tuolumne River (US).

Some material from Vernal Fall, *Abrams 4602* (S), *4594* (S, P, US) is unusually glabrous.

✓ 5. H. rubescens Torr. var. versicolor (Greene) n. comb.
H. versicolor Greene, Leaflets Botan. Obs. 1:112. 1905.
H. leptomeria Greene, l. c.

Petioles sparingly hirsute; leaf-blades cordate or reniform; hypanthium cylindric, including the sepals 5-6 mm. long, glandular-puberulent and pilose, especially above; petals 3.5-4 mm. long, about 8 or 10 times as long as wide; stamens 4-5 mm. long.

Type locality, moist shady bluffs, Hillsboro Peak, Black Range, New Mexico. Ranging from the Rincon and Huachuca Mts. of southern Arizona through the Mogollon and Black Ranges of southern New Mexico to the Guadalupe Mts. of western Texas. Material examined: New Mexico: Hillsboro Pk., *Greene 1203, type collection* (NY, P, US); Organ Mts., *Wooton in 1895* (NY), *in 1893,* type of *H. leptomeria* (US), *553* (US), *Vasey in 1881* (NY).———Arizona: White Mts., Bonita Creek, *Goodding 1234* (US); Huachuca Mts., *Goodding 180* (NY); Chiricahua Mts., Barefoot fire station, *Eggleston 10824* (US), *10789* (US), Rustler's Park, *Goodman and Hitchcock 1180* (NY, S), Monument Pk., *Blumer 1458* (S, US); Rincon Mts., *Nealley 106* (US), Manning Camp, *Blumer 3400* (S). ———Texas: Guadalupe Mts., McKittrick Canyon, *Moore and Steyermark 3584* (NY).

Rydberg separated *H. versicolor* and *H. leptomeria* on the basis of the hypanthium, the latter species having it deeply turbinate, the former campanulate, turbinate only at the base. I cannot maintain such a separation on this basis or that of petal width, which seemed at first to warrant a division. Then too, the geographical distribution makes the fusion of these two entirely possible. *H. versicolor* and *H. leptomeria* were both described by Greene in 1905, so page priority was used in referring the two to *H. rubescens var. versicolor.*

Versicolor is very near to *nana* and differs from it chiefly in the more elongate hypanthium. But some material from the region in which *versicolor* grows is quite difficult to place definitely: White Mts., Ariz., *Goodding 638* (NY), *1160* (NY), *Ellis 22* (US).

6. H. rubescens Torr. var. elegans (Abrams) Jeps., Man. Fl. Pls. Calif., 463, 1925.
H. elegans Abrams, Bull. S. Calif. Acad. 1:67: 1902.

Petioles hairy; leaf-blades rounded-reniform or cordate; hypanthium cylindric, in age urceolate, including the sepals 6-8 mm. long, pilose; petals 6 mm. long, about 4 times as long as wide; stamens 3.5 mm. long.

Type locality, Martin's Camp, Mt. Wilson, L. A. County, Calif. Growing in the San Gabriel Mountains of So. Calif. mostly between 4500 and 8500 ft. Material examined: Acton, *Elmer 3687* (NY, P, S, US); Mt. Wilson, Martin's Camp, *Abrams 2582* (NY, S, US); Strawberry Peak, *Peirson 4639* (FP, P); So. Fk. Rock Creek, *Peirson 7975* (FP); Mt. Lowe, *Grant 570* (P, S); Kelly's Cabin, *Johnston 1561* (P, S); North Baldy Mt., *Abrams and McGregor 600* (NY, S, US); Baldy Lookout, *Johnston 1733* (P, S); Lytle Creek, *Johnston 1456* (NY, P); Ontario Peak, *Munz 6090* (P); Cascade Cañon, *Johnston in 1928* (P); Cucamonga Pk., *Johnston 1559* (P, S); Middle Fk. Bear Creek, *Johnston 5296* (P).

The type was not available for study, but numerous collections from the type locality make it perfectly certain what the true *H. rubescens* var. *elegans* is. The unusually broad petals and subcylindric hypanthium characterize this variety. This variety is quite definitely restricted to the San Gabriel Mts., but is approached in the width of petals by such plants as *Jaeger 1040* (P) and *Hall 702* (US) from the San Jacinto Mts., although these specimens seem best referred to var. Parishii.

7. H. rubescens Torr. var. Parishii (Rydb.) Jeps., Man. Fl. Pls. Calif., 463, 1925.
H. Parishii Rydb., N. Am. Fl. 22:109. 1905. *H. hirsuta* Rydb., l. c.

Petioles hairy; leaf-blades cordate; hypanthium quite cylindric, including the sepals 5-6 mm. long, glandular-puberulent and somewhat pilose above; petals 3.5-4.5 mm. long, about 6 times as long as wide; stamens 4-5 mm. long.

Type locality, Mill Creek, San Bernardino Mts., Calif. Growing mostly between 6000 and 11,000 ft., in the San Bernardino and San Jacinto Mts. Material examined: San Bernardino Mts: Bear Creek at 6600 ft., *Ewan 2757* (P); North Fork of Bear Creek, *Johnston 2853* (P); Mill Creek, *Parish 2512,* type (NY); Snow Canyon, *Parish 8528* (S), *5062,* type coll. of *hirsuta* (NY, S); Hunsacker Flat, *Hall 1359* (NY); So. Fork of Santa Ana R., *Wilder 259* (P); Big Meadows, *Munz and Johnston 8548* (P).————San Jacinto Mts: Tahquitz Creek, *Jaeger 472* (US); San Jacinto Mt., *Hoffmann in 1929* (P); San Jacinto Peak, *Munz 6044* (P).

Rydberg's separation of *H. hirsuta* from *H. Parishii* was on the basis of more acute teeth on the leaves and greater hairi-

ness on the dorsal surface. It may be mentioned that the type localities for both his species are in the same canyon and at about the same altitude. An examination of both types as well as other specimens from the immediate region of the type locality fails to reveal any constant differences. The greater hairiness of the one may well be ecological.

Two specimens, East Fork of Lost Creek, *Munz and Johnston 8595* (P), 8602 (P), seem to intergrade between var. *Parishii* and var. *Abramsii,* having the glandular-puberulence of the hypanthium of *Abramsii,* but the longer flower and more hairy petioles of *Parishii.*

✓ 8. H. rubescens Torr. var. Abramsii (Rydb.) n. comb.
H. Abramsii Rydb., N. Am. Fl. *22*:109. 1905.

Petioles sparingly glandular-puberulent; leaf-blades reniform or cordate; hypanthium cylindric, including the sepals about 4 mm. long, glandular-puberulent; petals 4-5 mm. long, about 4-5 times as long as wide; stamens about 3-3.5 mm. long.

Type locality, Mt. San Antonio, San Bernardino County, Calif. Growing mostly between 8500 and 11,000 ft., in the San Bernardino Mts. and eastern end of the San Gabriel Mts. Material examined: San Bernardino Mts: Mt. San Gorgonio (Grayback), *Abrams and McGregor 753* (NY, S), *Munz 6205* (P); Sugarloaf Mt., *Munz 10774* (P); Dollar Lake, *Munz 12652* (P).————San Gabriel Mts. (San Antonio Mts.): Baldy, *Johnston 1728* (P, S); Mt. San Antonio, *Saunders in 1915* (S), *Abrams 1924,* type coll. (NY, S), *Munz 6113* (P); Mt. Islip, *Ewan 2663* (P).

A specimen from the Coldwater Fork of Lytle Creek, *Johnston 1395* (P) seems to be an intergrade between *Abramsii* and *elegans.* It has the larger broadly spatulate petals of *elegans,* but the glandular hypanthium of *Abramsii.*

✓ 9. H. rubescens Torr. var. caespitosa (Eastw.) n. comb.
H. caespitosa Eastw., Proc. Calif. Acad. Sci. II, 6:426. 1896.

Petioles sparingly hirsute; leaf-blades cordate; hypanthium short, campanulate, including the sepals 4-5 mm. long, glandular-puberulent, scarcely pilose above; petals 4 mm. long, about 4 times as long as wide; stamens 3.5-4 mm. long.

Type locality, San Emidio Cañon, Kern County, Calif. Known only from Tehachapi Mountains. Material examined: San Emidio Cañon, *Jasper in 1895,* isotype (US); Tehachapi Peak, *Dudley 318* (S); Bisse's Station, *Dudley 318a* (S).

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A REVISIONAL STUDY OF THE SPECIES ERIGERON FOLIOSUS NUTT.

By Gladys Compton

This paper presents an attempt to work out the varieties which may be recognized in *Erigeron foliosus Nutt.*, a species which shows remarkable variation with great intergradation between its varieties, but for the most part distinct from other species. It does intergrade with *E. Breweri* Gray, especially in those forms where the corymbs become reduced. In general the specific diagnostic characters used by Jepson (Man. Fl. Pls. Calif., 1051. 1925) are quite satisfactory.

In making this study there has been available material from the following herbaria: University of California (C), Pomona College (P), Rancho Santa Ana (Sa), and United States National Herbarium (U. S.). The letters indicated above after the herbarium names are those used in citing specimens. I am greatly indebted to Dr. Herbert L. Mason of the University of California, Dr. C. B. Wolf of the Rancho Santa Ana Herbarium, and Dr. William R. Maxon of the United States National Herbarium for their kindness in lending material for study.

Erigeron foliosus Nutt., Trans. Am. Philos. Soc., ser. 2, *7*: 309, 1841.

Stems simple below, corymbosely branched in inflorescence, erect, arising from a branching root-crown, equably leafy with leaves somewhat reduced above; leaves sessile, more or less strigose-hispidulous, filiform to oblanceolate; heads corymbosely arranged, hemispherical; involucral bracts in 3 series; rays about 30 to 40; achenes usually pubescent.

Key to Varieties

Achenes glabrous; stems 3-4 mm. thick; leaves linear, stiff-canescent. San Luis Obispo and northern Santa Barbara Cos. .....6. var. *Blochmanae*

Achenes pubescent.

Stems flexuous, slender, retrorse-hispidulous; leaves linear to spatulate, 1-2 cm. long, 1-5 mm. wide; corymb very open. Owens Valley, Calif. and adjacent Nevada. .....5. var. *porphyreticus*

Stems straight, the hairs not retrorse.

Leaves oblong to oblanceolate, with stiff hairs distinctly widened at the base; stems hispidulous.

Plant green, more or less hispid-pubescent but not canescent. Widespread through California. .....1. var. *typicus*

Plant canescent with extremely stiff, coarse, almost lanceolate hairs. Southwestern and western Mohave Desert. .....2. var. *Covillei*

Leaves linear, or if broader with hairs not noticeably widened at base; stems usually subglabrous.

Stems slender, usually 1-2 mm. thick; leaves plane, the hairs not noticeably widened at base. San Luis Obispo Co., Calif. to Ore. .....4. var. *Hartwegii*

Stems 3-5 mm. thick; leaves inrolled, the hairs widened at base. L. Calif. to San Francisco. ....3. var. *stenophyllus*

1. *Erigeron foliosus* Nutt. var. *typicus* n. nom. *E. foliosus* Nutt., Trans. Am. Philos. Soc. ser. 2, 7:309. 1841.

Stems 3-6 or more dm. tall, 3-5 mm. thick; leaves linear-oblong to oblanceolate, 2-4 cm. long, 2-4 or more mm. wide, reduced above; herbage rough-hispid; pubescence usually general over involucre, stem and leaves.

Type locality, Santa Barbara, California. Ranging through cismontane California into Lower California. Material studied,—CALIFORNIA: Van Duzen R., *Tracy 1241* (C); Mad R., *Chestnut and Drew in 1888* (US); Little Chico, *Bruce 1990* (P); Ione, *Braunton 1019* (US); Duncan's Mills, *Jones in 1882* (P); Marin Co., *State Survey 2387* (C); San Francisco, *Jones in 1883* (P); Mt. Diablo, *Abrams 7501* (P); Saratoga, *Davy 329* (C); Yosemite Valley, *King in 1907* (C), *Keck 179* (P); North Fork of Kings R., *Hall and Chandler 557* (C); Sequoia Nat. Park, *Munz 1526* (P); Paso Robles, *Blochman in 1893* (C); Santa Barbara, *Abrams 4111* (P); Painted Cave Ranch, *Eastwood 71* (C); Santa Rosa Islands, *Brandegee in 1888* (C); Santa Catalina Island, *Trask in 1898* (US); Head of Sheep Creek, San Gabriel Mts., *Munz 4561* (P); Head of Evey Canyon, *Johnston in 1924* (P); San Antonio Canyon, *Baker 3658* (C, P); Mountain Home Canyon, San Bernardino Mts., *Hall 7502* (C, P); Santa Ana R., *Munz 6332* (C, P); Baldwin Lake, *Munz 10744* (P); Mill Creek, *Munz 7586* (P); San Bernardino, *Parish 3673* (C); Bloomington, *Parish 11267* (C, P); Griffith Park, *Braunton 539* (C, US); Idyllwild, *Wright in 1929* (P); Chalk Hill, *Hall 2055* (C); Eastern base San Jacinto Mts., *Hall 1889* (P); near Cuyamaca Lake, *Abrams 3956* (P); Descanso, *Wolf in 1931* (Sa); Campo Hills, *Abrams 3730* (P); Doane Valley, *Munz 8303* (P). LOWER CALIFORNIA, Guadalupe, *Brandegee in 1893* (C).

2. *Erigeron foliosus* var. *Covillei* (Greene) n. comb. *E. Covillei* Greene, Erythea 3:20. 1895.

Similar to var. *typicus* but more grey with a very dense pubescence of coarse, hispid, almost lanceolate hairs.

Type locality, "Crystal Spring," Coso Mts., Inyo Co., Calif. Ranging in western Mohave Desert. Material studied, CALI-

FORNIA: Victorville, *Johnston in 1920* (P); Hesperia, *Spencer 400* (P); Phelan, *Peirson in 1922* (P), *Munz 6885* (P); Deadman's Point, *Parish 10777* (C, P); Keyes Ranch, Little San Bernardino Mts., *Munz and Johnston 5291a* (P).

None of the cismontane material of *typicus* is quite so stiff- and greyish-hispid as the plants from the Victorville region. The specimen cited from Keyes Ranch, *Munz and Johnston 5291a,* has unusually narrow leaves.

3. *Erigeron foliosus* var. *stenophyllus* (Nutt.) Gray, Bot. Calif. 1:330. 1876.

E. stenophyllus Nutt. Pl. Gamb., 21. 1848.

E. foliosus var. *tenuissimus* Gray, Syn. Fl. 1, pt. 2:215. 1884.

E. tenuissimus Greene, Pitt. 3:25. 1896.

E. Nuttallii Heller, Bull. Torr. Bot. Club 25:628. 1898.

E. Setchellii Jeps., Fl. W. Mid. Calif. 568. 1901.

E. fragilis Greene, Bull. So. Calif. Acad. 1:39. 1902.

Habit of *E. foliosus* var. *typicus* but with stems subglabrous; leaves linear to filiform, 1-3 mm. wide, often contorted, with large lanceolate, appressed hairs along margins.

Type locality given by Nuttall as "In California, (Monterey?)", but probably Santa Barbara or San Diego. Ranging from San Luis Obispo Co. south to L. Calif. Material studied—CALIFORNIA: McGinnes, 25 miles N. E. of San Luis Obispo, *Palmer 176½* (C); Walker Basin, *Grinnell 383* (US); Fort Tejon, *de Vasey 41* (US); Santa Cruz Island, Smuggler's Cove, *Abrams and Wiggins 181* (C); Santa Barbara, *Jones 229* (P); Frazier Mt., *Baldwin 101* (C); Santa Susana Pass, *Howell 1024* (Sa); Lancaster, *Elmer 3737* (P); Pine Mt., San Gabriel Mts., *Johnston 1682* (C, P); Blue Ridge, Swartout Valley, *Munz 778* (C, P); Mt. Wilson, *Grinnell 898* (C); Little Green Valley, San Bernardino Mts., *Hall 29* (C); Cushenberry Canyon, *Munz 10937* (P); Santa Monica Canyon, *Barber in 1897* (C); Little Santa Anita Canyon, *Abrams 2644* (P); Trabuco Canyon, *Hall 1379* (C); Temecula Canyon, *Munz 7133* (C, P); San Jacinto, *Spencer 2214* (P); near Poppet Flat, *Munz and Johnston 8840* (P); Van de Venter's, *Hall in 1899* (C); Jacumba, *Abrams 3657* (P); Pala grade, *Munz 10374* (P); Oriflame Canyon, *Abrams 3937* (P); Fallbrook, *Munz and Harwood 3892* (P); Laguna Mts., *Randall in 1918* (P); Vallecito Canyon, *Munz 9722* (P). LOWER CALIFORNIA: Hanson's Ranch, *Orcutt 1000* (C); San Rafael, *Orcutt in 1884* (C).

In his "Compositae of Southern California" (U. Calif. Pub. Bot. 3:91. 1907), Hall maintained *tenuissimus* as a variety distinct from *stenophyllus* on the basis of shorter leaves and smaller heads, but I have been unable to maintain such distinction.

4. *Erigeron foliosus* var. *Hartwegii* (Greene) Jepson, Man. Fl. Pls. Calif. 1056. 1925.

E. Hartwegi Greene, Erythea 3:21. 1895.

E. confinis Howell, Erythea 3:25. 1895.

E. foliosus var. *confinis* (Howell) Jeps. l. c.

E. Blasdalei Greene, Erythea 3:124. 1895.

Stems slender, usually 1-2 mm. thick, 1-2 (5) dm. high, subglabrous; leaves linear, usually ascending, 0.5-1.5 mm. wide, sparsely or quite pubescent with slender, generally appressed, evenly distributed, and not very stiff hairs; heads frequently solitary.

Type locality "foothills of the Sierra Nevada." Ranging from southern Oregon to Monterey and Merced Cos. Calif. Material studied—OREGON: Gold Beach, *Henderson in 1929* (C); Mt. Jefferson, *Nelson 2868* (C); Siskiyou Mts., *Cusick 2916* (C), *Howell 1507,* type collection of *confinis* (C). CALIFORNIA: Granite Peak, *Baker 241a* (C); Russian Creek, *Butler 949* (C); Hoopa Valley, *Davy and Blasdale 5713* (C); Klamath R., *Chandler 1427* (C), *Goddard 176* (C); Francis Range, Humboldt Co., *Davy and Blasdale 5886* (C); Bear R., Placer Co., *Hall 10154* (C); American R., *Bolander 4536* (US); Ione, Amador Co., *Braunton 1319* (C); McCormic's Bridge, Calaveras Co., *Blasdale in 1895* (C); Milton, *Davy 1320* (C), *Davy 1319* (C); So. Fork, Merced R., *Hall 8847* (C); San Carpojo, Monterey Co., *Condit in 1912* (C), *Unangst 901* (C).

This variety, as here constituted, is exceedingly variable, but is characterized by its fine pubescence as compared with that of *typicus.* It intergrades with *typicus* in leaf-shape and general habit, for example: Grasshopper Ridge, Canoe Creek, Humboldt Co., *Tracy 4756* (C); near Lincoln, Placer Co., *Heller 12749* (C); New York Falls, Amador Co., *Hansen 1425* (C). *Unangst 901,* above cited, approaches *stenophyllus.*

In general, plants from the coast ranges are lower than those from the foothills of the Sierra Nevada, and it seemed for a while as if two varieties, *confinis* and *Hartwegii,* should be maintained, but such plants as *Chandler 1427, Goddard 176, Condit in 1912, and Davy and Blasdale 5886* break the distinction altogether.

5. *Erigeron foliosus* var. *porphyreticus* (Jones) n. comb.
E. porphyreticus Jones, Contr. West. Bot. 8:33. 1898.

Stems slender, 1.5-2.5 mm. thick, 2-3 dm. tall, leafy, branched, flexuous; leaves linear to spatulate, 1-2 cm. long, 1-5 mm. wide; stems densely pubescent with short, stiff, retrorse hairs; heads in open corymb, often on rather long branches.

Type locality, Hawthorne, Nevada. Ranging through Owens Valley, Calif. and adjacent Nevada. Material studied—NEVADA: Hawthorne, *Jones in 1897,* type coll. (P, US). CALIFORNIA: Benton Station, *Jones in 1927* (P); Lone Pine, *Jones in 1897* (P); Soda Springs, Upper Kern R., *Hall and Babcock 5328* (C).

This variety has heretofore usually been treated as a species (cf. Jepson, Man. Fl. Pls. Calif., 1056. 1925), but apparently intergrades freely with *E. foliosus.* Two collections from Nevada: Reno, *Hillman in 1894* (P) and Franktown, Hillman in 1893 (P), have leaf-shape and spreading hairs much like *typicus; Coville and Funston 1604* from No. Fork of Kern R., Calif. (US) has the leaves of *stenophyllus* and the hairs on the stem are not retrorse.

6. *Erigeron foliosus* var. *Blochmanae* (Greene) Hall, Univ. Calif. Pub. Bot. 3:91. 1907.
E. Blochmanae Greene, Pitt. 3:25. 1896.

Stems stout, 3-4 mm. thick, 3.5-5 dm. tall; leaves linear, 2-4 cm. long, 1-1.5 mm. wide, more or less contorted, stiff-canescent; heads in dense corymbs; achenes nearly or quite glabrous.

Type locality "Sandy beaches, northern part of Santa Barbara Co.", ranging in sand dunes along coast of San Luis Obispo and northern Santa Barbara Cos. Material studied—CALIFORNIA: Coast Hills, San Luis Obispo Co., *Summers 416* (C); Oceano, *Condit* in 1910 (C); Santa Maria, *Eastwood 784* (C); Surf, *Wolf 2306* (Sa).

This is quite a distinct variety of limited range.

Pomona Colege,
Claremont, California.

A CORRECTION

In the September-December, 1933, issue of the BULLETIN on page 122 occurs a typographical error.

In the bottom line, referring to *Opuntia acanthocarpa,* the word "distinction" occurs. This should be deleted and the word "distribution" substituted for it.

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"	25,	"	3.	September,	1926	.25
"	26,	"	1.	January,	1927	.25
"	26,	"	2.	April,	1927	.25
"	26,	"	3.	September,	1927	.25
"	27,	"	1.	January,	1928	.25
"	27,	"	2.	May,	1928	.25
"	27,	"	3.	September,	1928	.25
"	28,	"	1.	January,	1929	.25
"	28,	"	2.	May,	1929	.25
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"	29,	"	3.	September,	1930	.25
"	30,	"	1.	January,	1931	.25
"	30,	"	2.	May,	1931	.25
"	30,	"	3.	September,	1931	.25
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BULLETIN OF THE

Southern California Academy of Sciences

LOS ANGELES, CALIFORNIA

Vol. XXXIII May - August, 1934 Part 2

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Issued Aug. 31, 1934

Southern California Academy of Sciences

A NEW HELMINTHOGLYPTA FROM THE EAST SLOPE OF THE SIERRA NEVADA, CALIFORNIA

By G. Willett

Pl. 20, Figs. *a*, *b* and *c*.

Conchologists of California have frequently commented on the fact that no helicoid snail has been known to occur along the desert slope of the southern Sierra Nevada. Therefore it was with much interest that the writer learned that, during the past winter, Mr. Morris E. Caruthers had received a specimen of Helminthoglypta from that region. This shell, an adult in good condition, though lacking most of the epidermis, was picked up by Mrs. Vernon L. Carr, of Inyokern, at an altitude of about 7,000 feet in Morris Canyon, a branch of Indian Wells Canyon, Kern County, California, during the early part of the past winter.

On March 25, 1934, Mr. Caruthers and the writer drove to the locality where Mrs. Carr had found the specimen, and camped. A diligent search of the mountain side, which was quite steep, and well covered with oak and piñon trees, was made during the afternoon and again the following morning. A very few fragments, too small to be of value, were brought to light, and Mr. Caruthers was fortunate enough to find one living specimen, about two-thirds grown and in perfect condition. It was adherent to a small stick in a tangle of debris in a gully on the mountain side. This specimen, together with the one found by Mrs. Carr, clearly show this snail to be very different from any species known to the writer, and it is, therefore, here named and described. The dead shell, being fully adult, is used as the type and from it the measurements are taken. The description of color, sculpture, etc. are from the paratype, No. 6562 collection of Morris E. Caruthers.

Helminthoglypta caruthersi, sp. nov. Description: Shell large, flattened, openly umbilicated, the inner lip slightly reflected over the umbilicus. Aperture broadly extended, considerably wider than high; lip thin, narrowly reflected, somewhat deflected between the shoulder and the suture; columellar margin dilated. Color yellowish brown with narrow chestnut-brown band at the shoulder (about 1½ millimeters wide). Spiral sculpture absent; growth wrinkles rather prominent, though uneven and closely spaced. Entire surface covered with fine papillations which are somewhat worn off on the earlier whorls. Color of animal, drab; spotted, dashed and scrawled with chocolate-brown.

Type: No. 1039 collection Los Angeles Museum, collected by Mrs. Vernon L. Carr at about 7,000 feet altitude in Morris Canyon, Kern Co., California. Measurements of type in millimeters: Greater diameter, 27.5; altitude, 13.4; width of aperture, 14.2; altitude of aperture, 12.

Remarks: This species is evidently of the desert group of Helminthoglyptas, of which *H. fisheri* (Bartsch) and *H. mohaveana* Berry are examples. In general features it is, perhaps, closest to the last named, but differs from it in much larger size, more depressed form, flaring aperture, deflected lip, and duller surface.

The writer takes pleasure in naming this species for Mr. Morris E. Caruthers, through whose energy much has been learned regarding the distribution of many of our west American shells.

Los Angeles Museum, Los Angeles, California,
April 27, 1934.

a. *b.* *c.*

PLATE 20

Helminthoglypta caruthersi Willett. Natural size.

PLEISTOCENE MOLLUSKS FROM THE TRES MARIAS ISLANDS, CEDROS ISLAND, AND SAN IGNACIO LAGOON, MEXICO

Leo George Hertlein

This paper is the result of the study of collections of Pleistocene fossils from Maria Madre and Maria Magdalena Islands, of the Tres Marias group, and Cedros Island and San Ignacio Lagoon, Lower California. The greater part of the fauna listed was collected by Mr. Henry Hemphill, Mr. W. H. Ochsner, Dr. G. D. Hanna and Mr. E. K. Jordan. The notes on the sedimentary deposits and their fossil content, extends our knowledge of the distribution and character of the Pleistocene along the west coast of North America. The writer wishes to express his appreciation for assistance in the determination of certain of the species by Mr. A. M. Strong and Dr. G. D. Hanna. The photographs of the new species illustrated herein were made by Dr. Hanna. Papers by Mr. E. K. Jordan dealing with similar deposits at San Quintin,[1] Magdalena Bay and at San Ignacio Lagoon,[2] have already been published.

Along the west coast of Lower California, raised beaches and terraces are rather common. Wittich[3] has pointed out that he has recognized marine beach deposits in Lower California which occur over 1000 meters above sea level. These were reported to contain shells of mollusks of recent appearance, which were considered to be subfossil.

Maria Madre Island

Fossiliferous beds on Maria Madre Island were mentioned by Grayson[4] and Nelson[5] and beds definitely referred to the Pleistocene were mentioned by Hanna[6], and E. K. Jordan and Hertlein[7]. The fauna listed in this paper from Maria Madre and Maria Magdalena Islands, was collected by Dr. G. D. Hanna and

---

[1] Jordan, E. K., Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 7, 1926, pp. 241-255. 1 textfigure and 1 plate.

[2] Jordan, E. K., Bull. South. Calif. Acad. Sci. vol. 23, pt. 5, September-October (issued October 25), 1924, pp. 145-146.

[3] Wittich, E., Contribucion a la Geologica de la Region meridional de la Baja California. Bol. Soc. Geol. Mexicana, vol. 6, pt. 1, 1909, p. XIII and pp. 9-12. —Strandlinien an der Südküste von Niederkalifornien, Globus, Bd. 97, 1910, p. 379. —Uber Meeresschwankungen an der Küste von Kalifornien, Zeitschr. Deutsch. Geol. Gesellsch. Monatsber, 1912, pp. 505-512.—La emersión moderna de la costa occidental de la Baja California, Soc. cient. Antonio Alzate, (Mexico), Mem., vol. 35, nos. 3-4, 1920, pp. 121-144, 10 pls., 1 fig.—See also G. Eisen, Proc. Calif. Acad. Sci. ser. 2, vol. 5, 1895, p. 754.—Darton, N. H., Geologic reconnaissance in Baja California, Journ. Geol. vol. 29, no. 8, November-December, 1921, pp. 720-748, 22 figs. —Hanna, G. D., Nat. Geogr. Mag. vol. 44, no. 1, 1923, p. 99.

[4] Proc. Boston Soc. Nat. Hist. vol. 14, 1871, pp. 261-303.

[5] North American Fauna, no. 14, U. S. Dept. Agric. (Natural History of the Tres Marias Islands), 1899, pp. 1-97.

[6] Pan-Amer. Geol. vol. 48, no. 1, 1927, pp. 20-21.—Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 1, 1926, p. 75.

[7] Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 4, 1926, p. 210.

E. K. Jordan, during the Expedition of the California Academy of Sciences to the Revillagigedo Islands in 1925.

The collection made at the Salt Works on the east side of the island, Loc. 1834 (C. A. S.), came from beds made up of shell fragments and may be considered to be a coquina. The beds are only a few meters in thickness and are exposed for some distance along the coast.

The species represented are similar to those of the Upper Pleistocene at Magdalena Bay.[8] In their recent habitat nearly all the species are found at the Tres Marias Islands,[9] but a few are found only in the Gulf of California and to the south. These beds on Maria Madre can be assigned to the Upper Pleistocene.

The shells from Loc. 1838 (C. A. S.), at the light house by the village, are from a raised beach and their recent appearance suggests that they are subfossil.

A few specimens were collected from Loc. 1839 (C. A. S.), from the north end of the island. These are apparently from a raised beach and can be assigned to the late Pleistocene.

Loc. 1834 (C. A. S.) Maria Madre Island, Mexico, at Salt works on east side of the island, about 215 meters inland. G. D. Hanna and E. K. Jordan collectors, 1925. Pleistocene.

Loc. 1838 (C. A. S.) Maria Madre Island, Mexico. At light house at the village. General pink Pleistocene. G. D. Hanna and E. K. Jordan, collectors, 1925. Raised Beach. Subfossil.

Loc. 1839 (C. A. S.) Maria Madre Island, Mexico. Pleistocene at North East end of Island. Raised Beach. G. D. Hanna and E. K. Jordan, collectors, 1925. Pleistocene.

List of Species from the Pleistocene of Maria Madre Island

Antigona rigida Dillwyn, Loc. 1839 (C. A. S.).
Apolymetis alta Conrad, Loc. 1834 (C. A. S.).
Arca multicostata Sowerby, Loc. 1834 (C. A. S.).
Cardium biangulatum Sowerby, Loc. 1834 (C. A. S.).
Cardium consors Broderip & Sowerby, Loc. 1834 (C. A. S.).
Cardium elenense Sowerby, Loc. 1834 (C. A. S.).
Cardium sp., Loc. 1834 (C. A. S.).
Chione mariae d'Orbigny, Loc. 1834 (C. A. S.).
Chione succincta Valenciennes, Loc. 1834 (C. A. S.).
Chione undatella Sowerby, Loc. 1834 (C. A. S.).
Codakia distinguendo Tryon, Loc. 1834 (C. A. S.).
Divaricella eburnea Reeve, Loc. 1834 (C. A. S.).

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[8] In Mr. Jordan's paper in 1924 two faunal lists are given which refer to an Upper and a Lower Quaternary fauna from Magdalena Bay. Insufficient information regarding the collections upon which he based his conclusions regarding two horizons, raised an element of doubt regarding the exact localities. After a visit to Magdalena Bay in 1925, Mr. Jordan stated verbally to the writer that only one horizon is present at Magdalena Bay and that it may be referred to the Upper Pleistocene. A report by Mr. Jordan on the collections from this locality is now awaiting publication.

[9] See A. M. Strong and G. D. Hanna, Marine mollusca of the Tres Marias Islands, Mexico, Proc. Calif. Acad. Sci. ser. 4, vol. 19, no. 3, 1930, pp. 13-22.

Glycymeris multicostata Sowerby, Loc. 1834 (C. A. S.).
Macrocallista orcutti Dall, Loc. 1834 (C. A. S.).
Macrocallista squalida Sowerby, Loc. 1834 (C. A. S.).
Pecten circularis Sowerby, Loc. 1834 (C. A. S.).
Pecten latiauratus Conrad, Loc. 1834 (C. A. S.).
Pecten subnodosus Sowerby, Loc. 1838 (C. A. S.).
Phacoides lamprus Dall, Loc. 1834 (C. A. S.).
Pitar concinna Sowerby, Loc. 1834 (C. A. S.).
Placunanomia cumingii Broderip, Loc. 1834 (C. A. S.).
Pteria (Pinctada) mazatlanica Hanley, Loc. 1834 (C. A. S.).
Venericardia flammea Michelin, Loc. 1834 (C. A. S.).
Cadulus tolmiei Dall, Loc. 1834 (C. A. S.).
Dentalium fischeri Stearns, Loc. 1834 (C. A. S.).
Dentalium quadrangulare Hanley, Loc. 1834 (C. A. S.).
Acmaea rosacea Carpenter, Loc. 1834 (C. A. S.).
Acteocina angustior Baker & Hanna, Loc. 1834 (C. A. S.).
Anachis coronata Sowerby, Loc. 1834 (C. A. S.).
Architectonica granulata Lamarck, Loc. 1834 (C. A. S.).
Callistoma cf. *tricolor* Gabb, Loc. 1834 (C. A. S.).
Clava gemmata Hinds, Loc. 1834 (C. A. S.).
Clavus (Cymatosyrinx) aeolia Dall, Loc. 1834 (C. A. S.).
Conus lucidus Mawe, Loc. 1834 (C. A. S.).
Conus tornatus Broderip, Loc. 1834 (C. A. S.).
Crucibulum imbricatum Sowerby, Loc. 1834 (C. A. S.).
Epitonium cf. *brunneopictum* Dall. Loc. 1834 (C. A. S.).
Eunaticina heimi E. K. Jordan, n. sp., Loc. 1834 (C. A. S.).
Fasciolaria princeps Sowerby, Loc. 1834 (C. A. S.).
Hemitoma (Emarginula) sp., Loc. 1834 C. A. S.).
Liotia cf. *carinata* Carpenter, Loc. 1834 (C. A. S.).
Melanella cf. *monicensis* Bartsch, Loc. 1834 (C. A. S.).
Modulus cerodes A. Adams, Loc. 1834 (C. A. S.).
Nassarius versicolor Adams, Loc. 1834 (C. A. S.).
Natica broderipiana Recluz, Loc. 1834 (C. A. S.).
Oliva splendidula Sowerby, Loc. 1834 (C. A. S.).
Oliva sp., Loc. 1834 (C. A. S.).
Olivella gracilis Sowerby, Loc. 1834 (C. A. S.).
Olivella cf. *pedroana* Conrad, Loc. 1834 (C. A. S.).
Polinices uber Valenciennes, Loc. 1834 (C. A. S.).
Pyrene cf. *strombiformis* Lamarck, Loc. 1834 (C. A. S.).
Strombina pulcherrima Sowerby, Loc. 1834 (C. A. S.).
Strombus granulatus Gray, Loc. 1834 (C. A. S.).
Turbo fluctuosus Wood, Loc. 1838 (C. A. S.).
Turbo saxosus Wood, Loc. 1834 (C. A. S.).
Turbo squamiger Reeve, Loc. 1834 (C. A. S.).
Vitrea indentata Say, Loc. 1834 (C. A. S.).
Worm tubes, Loc. 1834 (C. A. S.).
Balanus concavus pacificus Pilsbry, Loc. 1834 (C. A. S.).
Shark tooth, Loc. 1834 (C. A. S.).

Maria Magdalena Island

Pleistocene sediment on Maria Magdalena Island was reported by G. D. Hanna[10] as forming a thin veneer over the older rocks near the shore line along the middle of the north side. The beds and enclosed fauna are similar to those from the Salt works on the east side of Maria Madre Island. An Upper Pleistocene age can be assigned to these beds.

Loc. 1836 (C. A. S.) Maria Magdalena Island, Tres Marias Group, Mexico. Along beach cliffs about the middle of the north shore of Maria Magdalena Island. G. D. Hanna and E. K. Jordan collectors, 1925. Pleistocene.

List of Species from the Pleistocene of Maria Magdalena Island

Sponge.
Coral.
Echinoid spine.
Anomalocardia subimbricata Sowerby.
Arca multicostata Sowerby.
Arca mutabilis Sowerby.
Arca gradata Broderip & Sowerby.
Arca solida Sowerby.
Cardium biangulatum Sowerby.
Cardium consors Sowerby.
Cardium obovale Sowerby.
Cardium senticosum Sowerby.
Chama squamuligera Pilsbry & Lowe.
Chione succincta Valenciennes.
Codakia mexicana Dall.
Glans laticostata Sowerby.[11]
Glycymeris multicostata Sowerby.
Glycymeris tessellata Sowerby.
Macrocallista squalida Sowerby.
Nuculana impar Pilsbry & Lowe.
Nuculana taphria Dall.
Pecten circularis Sowerby.
Petricola robusta Sowerby.
Phacoides cancellaris Philippi.
Plicatula spondylopsis Rochebrune.
Spondylus crassisquama Lamarck (young specimens).

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[10] Proc. Calif. Acad. Sci. ser. 4, vol. 15, no. 1, 1926, pp. 72-73.—Pan-Amer. Geol. vol. 48, no. 1, 1927, p. 23.

[11] It may be mentioned here that the species commonly listed as *Cardita subquadrata* Carpenter (*Lazaria subquadrata* Carpenter, Rept. Brit. Assoc. Adv. Sci. for 1863 [Issued 1864], pp. 536, 627, 642. The type locality is Santa Barbara, California, according to I. S. Oldroyd, Stanford Univ. Publ. Univ. Ser. Geol. Sci. vol. 1, 1924, p. 111) was renamed *Cardita carpenteri* by Lamy (Jour. de Conchyl. vol. 66, no. 3, 1922, p. 264 "Californie.") due to an earlier use of the name by Conrad (*Cardita subquadrata* Conrad, Proc. Acad. Nat. Sci. Philadelphia, 1847, p. 298, Mississippi. Eocene). *Glans minuscula* Grant & Gale (Mem. San Diego Soc. Nat. Hist., vol. 1, 1931, p. 277, pl. 13, figs. 10a, 10b. "Upper Pleistocene terrace near Seacliff, Ventura Co.") thus becomes a synonym of *G. carpenteri* Lamy.

Acmaea ?atrata Carpenter (young specimen).
Acteocina ?angustior Baker & Hanna.
Aletes squamigerus Carpenter.
Alvania herrerae Baker, Hanna & Strong.
Anachis incerta Stearns.
Anachis pygmaea Sowerby.
Anachis ?vexillum Reeve.
Cancellaria sp.
Clava gemmata Hinds.
Conus (young) cf. *mahogani* Reeve.
Conus cf. *tornatus* Broderip (young).
Crepidula aculeata Gmelin.
Crepidula cf. *lingulata* Gould.
Crepidula nummaria Gould var.? *fimbriata* Reeve.
Crepidula cf. *onyx* Sowerby.
Crucibulum imbricatum Sowerby.
Crucibulum spinosum Sowerby.
Cypraea cf. *arabicula* Lamarck.
Cytharella carissima Pilsbry & Lowe.
Cytharella quadriseriata Dall.
Diadora inaequalis Sowerby.
Diadora murina Dall.
Diadora panamensis Sowerby.
Engina ferruginea Reeve.
Fissurella virescens Sowerby.
Fissurella sp.
Harpa crenata Swainson.
Hipponix antiquatus Linnaeus.
Hipponix barbatus Sowerby.
Hipponix grayanus Menke.
Hipponix tumens Carpenter.
Liotia ?rammata Dall.
Marginella cf. *M. californica* Tomlin.
Marginella phrygia Sowerby.
Mitra cf. *attenuata* Reeve.
Nassarius versicolor C. B. Adams.
Natica sp. (young) aff. *N. catenata* Philippi.
Nerita bernhardi Recluz.
Odostomia gallegosi Hertlein, new species.
Olivella cf. *gracilis* Broderip & Sowerby.
Oliva testacea Lamarck (young).
Oxystyla princeps Broderip.
Phasianella (Tricolia) *mazatlanica* Strong.
Philbertia aethra Dall.
Rissoina stricta Menke.
Rissoina townsendi Bartsch.
Seila assimillata C. B. Adams.
Siphonaria maura var. *aequilirata* Carpenter.

Strombina ?pulcherrima Sowerby.
Tegula globula Carpenter.
Teinostoma cecinella Dall.
Terebra sp.
Triphora cf. *stearnsi* Bartsch.
Turbo fluctuosum Wood.
Turritella nodulosa King.
Vermicularia eburnea Reeve.

San Ignacio Lagoon, Lower California

Mr. E. K. Jordan's[12] paper on Quaternary Molluscan faunas from Lower California, included a list of species and brief discussions of Pleistocene mollusks from San Ignacio Lagoon, Lower California. He considered this fauna to be of an Upper Pleistocene age and with this opinion the writer is in accord.

The present faunal list from San Ignacio Lagoon represents the species in the collection of the California Academy of Sciences, collected at that locality by Mr. Henry Hemphill, supplemented by the H. Hemphill collection at Leland Stanford Junior University and the one made by C. R. Swarts and T. J. Cullen (Loc. 38 L. S. J. U.), which was listed by E. K. Jordan. The species in the list followed by (S) are those in the collections of the Leland Stanford Junior University but not represented in the collections of the California Academy of Sciences. With much larger collections available for comparison, Mr. Jordan later indicated some corrections in the identifications of certain species which are listed in his paper in 1924. The corrections are indicated in the present list.

List of Species from the Pleistocene of San Ignacio Lagoon, Lower California

Encope micropora A. Agassiz.
Anomia peruviana d'Orbigny.
Apolymetis excavatus Sowerby.
Arca tuberculosa Sowerby.
Cardium elenense Sowerby (as *C. substriatum* Conrad, by Jordan, 1924).
Cardium procerum Sowerby (S).
Chione gnidia Broderip & Sowerby.
Chione succincta Valenciennes.
Chione undatella Sowerby.
Corbula luteola Carpenter (S).
Diplodonta sericata Reeve.
Donax californica Conrad.
Glans affinis Broderip.
Glycymeris giganteus Reeve (S).
Labiosa undulata Gould.

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[12] Bull. South. Calif. Acad. Sci. vol. 23, pt. 5, Sept.-Oct. 1924. Issued Oct. 25, 1924, pp. 151-152.

Macoma nasuta Conrad (S.) (as *M. inquinata* Deshayes by Jordan, 1924).
Macoma yoldiformis Carpenter (S).
Macrocallista squalida Sowerby.
Mactra californica Conrad (S).
Nuculana elenense Sowerby.
Ostrea palmula Carpenter.
Pecten circularis Sowerby (S).
Phacoides approximatus Dall.
Phacoides lingualis Carpenter.
Phacoides nuttalli Conrad.
Semele decisa Conrad.
Tagelus californicus Conrad.
Tellina buttoni Dall (S) (as *T. modesta* Carpenter by Jordan, 1924).
Tellina meropsis Dall.
Tellina reclusa Dall.
Tellina rubescens Hanley.
Dentalium inversum Deshayes (S.) (as *D. pretiosum* Sowerby by Jordan, 1924).
Dentalium sectum Deshayes (S).
Dentalium semipolitum Broderip & Sowerby (S).
Aletes squamigerus Carpenter.
Amphissa columbiana Dall.
Anachis coronata Sowerby.
Bulla punctulata A. Adams.
Calliostoma eximium Reeve.
Calliostoma palmeri Dall.
Cancellaria buccinoides Sowerby.
Cantharus elegans Gray.
Cerithidea californica Haldemann.
Cerithium stercus-muscarum Valenciennes (also as *C. ocellatum* Bruguiere, by Jordan, 1924).
Crepidula adunca Sowerby.
Crepidula excavata Sowerby.
Crepidula onyx Sowerby.
Crucibulum imbricatum Sowerby.
Crucibulum cf. *spinosum* Sowerby.
Cytharella sp.
Diadora murina Dall.
Eupleura muriciformis Broderip.
Fusinus dupetitthouarsi Kiener (S).
Glyphostoma aff. *G. adana* Dall.
Lucapinella callomarginata Carpenter.
Macron kellettii A. Adams.
Melanella cf. *oldroydi* Barsch.
Mitrella carinata Hinds.
Modulus disculus Philippi.
Murex erinaceoides Valenciennes.

Nassarius cf. *cerritensis* Arnold.
Nassarius tegula Reeve.
Neritina usurpatrix Crosse & Fischer.
Oliva angulata Lamarck.
Oliva spicata Bolten.
Olivella dama Mawe (S).
Olivella gracilis Broderip & Sowerby (S) (as *O. inconspicua* C. B. Adams by Jordan, 1924).
Olivella baetica var. *mexicana* T. S. Oldroyd.
Olivella pedroana Conrad (S).
Petaloconchus complicatus Dall.
Phyllonotus bicolor Valenciennes (S).
Phyllonotus radix Lamarck (S).
Polinices reclusianus Deshayes.
Pseudomelatoma penicillata Carpenter.
Purpura nuttalli Conrad.
Pyramidella mexicana Dall & Bartsch.
Pyrene strombiformis Lamarck.
Solenosteira anomala Reeve.
Strombina gibberula Sowerby (as *Nitidella ocellata* Gmelin, by Jordan, 1924).
Strombus gracilior Sowerby (S).
Tegula aureotincta Forbes.
Terebra variegata Gray.
Thais biserialis Blainville.
Tritonalia poulsoni Carpenter.
Turbo fluctuosus Wood.
Turbonilla buttoni Dall & Bartsch.
Turricula maculosa Sowerby (as *T. burragei* Bartsch by Jordan, 1924).
Turritella marmorata Kiener.
Turritella tigrina Kiener[13] (S).

Cedros Island

The mollusks from Cedros Island here listed occur on raised beaches from 15 to 30 meters above sea level and appear to be of a late Pleistocene age. These shells were collected by Mr. W. H. Ochsner in 1905 during the expedition of the California Academy of Sciences to the Galapagos Islands, and by Dr. Hanna in 1922, during the expedition of the California Academy of Sciences to Guadalupe Island.

Loc. 801 (C. A. S.). South Bay of Cedros Island. W. H. Ochsner collector, 1905-1906.

Loc. 931 (C. A. S.). West side of Cedros Island. Raised Beach. G. D. Hanna collector, 1922.

Loc. 2323 (C. A. S.). Raised Beach at South Bay, Cedros Island. G. D. Hanna collector, 1922.

[13] The species listed as *T. goniostoma* Valenciennes by Jordan, 1924, from the Quaternary of Scammon Lagoon, can be referred to *T. tigrina* Kiener or *T. leucostoma* Valenciennes.

List of Species from the Pleistocene of Cedros Island (Raised Beaches).

Phacoides californicus Conrad, Locs. 801; 931 (C. A. S.).
Tivela crassatelloides Conrad, Loc. 801 (C. A. S.).
Acanthina lugubris Sowerby, Loc. 2323 (C. A. S.).
Conus californicus Hinds, Loc. 931 (C. A. S.).
Fissurella volcano Reeve, Locs. 801; 931; 2323 (C. A. S.).
Haliotis cracherodii Leach, Loc. 2323 (C. A. S.).
Hipponix antiquatus Linnaeus, Loc. 931 (C. A. S.).
Lottia gigantea Gray, Locs. 801; 2323 (C. A. S.).
Megathura crenulata Sowerby, Locs. 931; 2323 (C. A. S.).
Norrisia norrisi Sowerby, Loc. 801 (C. A. S.).
Polinices reclusianus Deshayes.[14]
Tegula aureotincta Forbes, Locs. 801; 931; 2323 (C. A. S.).
Tegula gallina Forbes, Loc. 2323 (C. A. S.).
Thais biserialis Blainville, Loc. 2323 (C. A. S.).
Trivia californica Gray, Loc. 931 (C. A. S.).

Notes and Descriptions of Species

Odostomia gallegosi Hertlein, new species.

Plate 21, figure 3

Shell small, pupiform, rather thick, surface smooth and polished; nuclear whorls almost completely immersed in the first of the following whorls; postnuclear whorls 7, the early ones rounded, rapidly enlarging, the last 3 flattened, somewhat cylindrical, narrowly tabulated at the summit, somewhat contracted at the sutures, without visible sculpture; periphery rounded, marked by a narrow sulcus; base short, rounded; aperture oval, the posterior angle acute, falling a little below the sulcus which is exposed in the sutures on the later whorls; columbella short, curved, provided with a strong fold at its insertion, body of the shell with a thin callus. The type measures; length 4.5 mm., diameter, 1.8 mm.

Holotype No. 6059 (Calif. Acad. Sci. type coll.) from Loc. 1836 (C. A. S.) along the beach cliffs on about the middle of the north shore of Maria Magdalena Island, Tres Marias Group, Mexico. G. D. Hanna and E. K. Jordan Collectors. Pleistocene.

Mr. A. M. Strong has pointed out to the author that this species is quite distinct from any *Odostomia* described from western North America. The absence of all sculpture with the exception of the peripheral sulcus removes it from all the subgenera known from the west American fauna. In the key to the subgenera in the genus *Odostomia* by Dall & Bartsch[15] it would fall

[14] This species was reported fossil on Cedros Island by Stearns (Proc. U. S. Nat. Mus. vol. 17, 1894, p. 196 "fossil on Cerros Island", Albatross coll.).

[15] U. S. Nat. Mus. Bull. 68, 1919, p. 15. "Type, *Turbo nivosa* Montagu." (Montagu, Test. Britannica, vol. 2, 1803, p. 326. "Found in the sand on the south coast of Devon, very rare."——Forbes & Hanley, Hist. British Moll., vol. 3, 1853, p. 287, pl. 96, fig. 7.——Jeffreys, British Conch., vol. 4, 1867, p. 116.).

in the subgenus *Jordaniella,*[16] and furnishes the first record of this subgenus from western North America.

Eunaticina heimi E. K. Jordan, new species[17]

Plate 21, figure 4

Shell small, thin, naticoid, spire short with about 3 to 4 inflated whorls; surface sculpture by numerous fine spiral incised lines. These are crossed by fine lines of growth; umbilicate; aperture ovate; margins of inner and outer lip plain. Altitude 9.6 mm.; width of body whorl 7 mm.

Holotype No. 5557 (Calif. Acad. Sci. Type Coll.) from Loc. 754 (C. A. S.) Magdalena Bay, Lower California. G. D. Hanna and E. K. Jordan collectors; Pleistocene.

The slender form and ovate aperture easily distinguish this species from *Eunaticina oldroydii* Dall.[18] *Eunaticina heimi* is found living at Hood Island of the Galapagos Group. The species also occurs in the Pleistocene of Magdalena Bay, Lower California, and in the Pleistocene of Maria Madre Island, Mexico.

Macron kellettii A. Adams

Pseudoliva kellettii A. Adams, Proc. Zool. Soc. London, 1853, p. 185. *"Hab.*—?"—Sowerby, Thes. Conch. vol. 3, 1885, *Pseudoliva,* p. 75, pl. 116, fig. 12. "Hab.—?"—Carpenter, Rept. British Assoc. Adv. Sci. for 1863 [Issued 1864], p. 554. "[=*Macron (Zemira) Kellettii,* Mus. Cum.: = *Pusio trochlea,* Gray, MS. in Brit. Mus. Cerros Is., *Ayres*]."

Macron kellettii A. Adams, Tryon, Manual Conch. vol. 3, 1881, p. 214, pl. 82, fig. 477. "San Diego, Cal.; Gulf of California."

Macron aethiops (Reeve), var. *kellettii* (A. Adams), Grant & Gale, Mem. San Diego Soc. Nat. Hist. vol. 1, 1931, p. 650, pl. 28, fig. 8. Earlier records cited.

Macron kellettii is present in the Pleistocene at San Ignacio Lagoon, Lower California. It has been reported from the Pleistocene of southern California, and recent from San Diego, California, to the Gulf of California.

Due to uncertainty regarding the status of *M. kellettii* it is retained as a distinct species in the present paper.

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[16] *Jordaniella* Chaster, n. gen., Proc. Roy. Irish Acad., ser. 3, vol. 5, no. 1, 1898, p. 20 [name], p. 21 [under *J. nivosa* Montagu] "The *Turbo nivosus* of Montagu and the *Odostomia truncatula* of Jeffreys belong to a very distinct group for which I suggest the name *Jordaniella.*"

[17] Mr. E. K. Jordan has given a description of this species in a manuscript dealing with the Pleistocene of Magdalena Bay, Lower California. Mr. Jordan's description is given here to avoid the use of a *nomen nudum* in the list of species from the Pleistocene of Maria Madre Island.

[18] Nautilus, vol. 11, no. 8, 1897, p. 85. "deep water off Catalina Is., Cala." ——Dall, U. S. Nat. Mus. Bull. 112, 1921, p. 165, pl. 14, figs. 1 and 3.

The name *Purpura trochlea* Gray[19] is earlier than *Pseudoliva kellettii* A. Adams. Mr. E. A. Smith who studied the types of these two species, and of *Buccinum aethiops* Reeve, in the British Museum, has placed *Macron kellettii* in the synonymy of *M. trochlea* Gray. According to Smith, the type of *M. trochlea* is intermediate with respect to the grooving, between *M. aethiops* and *M. kellettii*. (See Jour. Conch. vol. 10, no. 12, 1903, p. 351).

Macron orcutti Dall (Proc. Biol. Soc. Washington, vol. 31, 1918, pp. 5-8. "Magdalena Bay, L. Cal., C. R. Orcutt.") is said to be distinct from *M. aethiops*. According to Dall, the species is finely, sharply, and uniformly, spirally striated.

Calliostoma palmeri Dall
Plate 21, figures 1 and 2

Calliostoma palmeri Dall, Amer. Jour. Conch., vol. 7, 1872, p. 125, pl. 15, fig. 15. "Guaymas, ten specimens, Dr. E. Palmer." —— Strong, Hanna and Hertlein, Proc. Calif. Acad. Sci., ser. 4, vol. 21, no. 10, 1933, pl. 5, figs. 1 and 2. San Felipe at the head of the Gulf of California.

The specimens referred to this species are young and somewhat weathered, but they are similar to Recent specimens of *Calliostoma palmeri* Dall. *C. bonita* Strong, Hanna and Hertlein,[20] has a different number of spiral threads, which are smooth instead of granular, and the Recent shells are more highly colored. The granular spiral threads as well as the low spire and slightly excavated umbilical region distinguish Dall's species from *C. eximium* Reeve[21] and *C. tricolor* Gabb.[22]

Plesiotype No. 6047 (C. A. S. type Coll.) from San Ignacio Lagoon, Lower California. H. Hemphill collector. Pleistocene.

Modolus disculus Philippi.

Trochus disculus Philippi, Zeitschr. für Malakozool. April, 1846, p. 51. "Mazatlan." —— Philippi in Küster, Conch.-Cab. Bd. 2, Abt. 3, 1846-1851, Taf. 36, fig. 14.

Modulus disculus Philippi, Tryon, Manual Conch. vol. 9, 1887, p. 261, pl. 48, figs. 93, 94. "Acapulco, Mazatlan." (Pl. 48, fig. 5 as *M. dorsuosus* Gould). —— Stearns, Proc. U. S.

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[19] *Purpura trochlea* Gray in Griffith's Cuvier's Animal Kingdom, vol. 12, 1834, pl. 32, fig. 14 [No description, or locality].

Pollia trochlea Gray, Gray, Zool. Beechey's Voyage, 1839, p. 111. [Description given, but no locality].

Pollia trochlea Gray, Tryon, Manual Conch. vol. 3, 1881, p. 277. "? = *Purpura trochlea*."

Macron trochlea Gray, E. A. Smith, Jour. Conch. vol. 10, no. 12, 1903, p. 351.

[20] Proc. Calif. Acad. Sci., ser. 4, vol. 21, no. 10, 1933, p. 121, pl. 5, figs. 5 and 6 "dredged in Acapulco Bay, Mexico."

[21] *Calliostoma eximium* Reeve. See Pilsbry, Manual Conch. vol. 11, 1889, p. 366, pl. 65, figs. 84, 85, 86. "Mazatlan; Cape St. Lucas; fossil in post tertiary at San Ignacio Lagoon."

[22] *Calliostoma tricolor* Gabb, Proc. Calif. Acad. Nat. Sci. vol. 3, 1865, p. 186. "Hab. San Pedro, five alive on the sand shoal; and Half Moon Bay, beach; also San Diego. Dr. Cooper. Also fossil in the Post Pliocene, San Pedro."—Pilsbry, Manual Conch. vol. 11, 1889, p. 370, pl. 67, fig. 52. "Santa Cruz to San Diego."

Nat. Mus. vol. 17, 1894, p. 192. "Tres Marias." Also Mazatlan, Acapulco, Panama. —— Petit de la Saussaye, Jour. de Conchyl. vol. 4, 1853, p. 136. "Mazatlan (Philip.)." —— Pilsbry & Lowe, Proc. Acad. Nat. Sci., Philadelphia, vol. 84, 1932, p. 123. "La Paz; Taboga Island."

Modulus dorsuosus Gould, Boston Jour. Nat. Hist. vol. 6, 1852, p. 383, pl. 14, fig. 12. "Found at Acapulco."

Modulus disculus Philippi occurs in the Pleistocene of San Ignacio Lagoon, Lower California. The high spire and the much less developed radial ribs easily distinguish this species from *M. cerodes* A. Adams[23] which occurs in the Pleistocene of Maria Madre Island and of Magdalena Bay, as well as living in the Gulf of California. *M. disculus* has a known range from Mazatlan, Mexico to Taboga Island, Panama. The species listed as *M. disculus* from Mozambique[24] by Petit de la Saussaye apparently represents another species.

Neritina usurpatrix Crosse & Fischer.

Neritina picta Sowerby, Proc. Zool. Soc. London, 1835, p. 201. "*Hab.* ad Panaman." —— Sowerby, Conch. Illustr., September 29, 1836, *Neritina,* p. 3, pl. 86, fig. 1. "Panama. —— Sowerby, Thes. Conch. vol. 2, 1855, p. 530, pl. 116, figs. 267, 268, 269. Panamà; on a mud-bank, partially overflowed with fresh water. *Cuming.*" —— Reeve. Conch. Icon. vol. 9, 1855, *Neritina,* pl. 23, figs. 101a, 101b, [Same record as the preceding reference.] —— Troschel, Das Gebiss der Schnecken, vol. 2, 1878, p. 176, pl. 16, fig. 9. [This reference not seen.] —— E. Von Martens, in Martini-Chemnitz Conchyl.-Cab. Ed 2, Bd. 2, Abt. 10, 1879, p. 191, pl. 19, figs. 22-25. [Reference not seen.] —— Tryon, Manual Conch. Ser. 2, vol. 10, 1888, p. 41, pl. 13, figs. 52-55. "Gulf of California to Panama." —— Stearns, Proc. U. S. Nat. Mus. vol. 17, 1894, p. 200. Coast of Lower California, Gulf of California, and south to Panama and beyond. —— Von Martens, Biologia Centrali-Americana, 1900, p. 589, pl. 28, figs. 8, 10, 13. Cites earlier records from Guaymas, Mexico, to Payta Peru.

Nerita (*Neritina*) *picta* Sowerby, Anton, Verzeich. der Conchyl. 1839, p. 29. [No locality given.] —— Recluz, Jour. de Conchyl. vol. 1, 1850, p. 152.

Vitta picta Sowerby, Mörch, Catalog. Conchyl. Yoldi, 1852, p. 167. "Panama."

Neritina (*Vitta*) *picta* Sowerby, Mörch, Malakozool. Blätter, Bd. 7, 1861, p. 170.

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[23] See Tryon, Manual Conch. vol. 9, 1887, p. 261, pl. 49, figs. 96 and 97.

[24] Petit de la Saussaye, Jour. de Conchyl. vol. 4, 1853, p. 135. "le détroit de Mosambique." A list of species of *Modulus* was given by Saussaye.

Neritella picta Sowerby, Binney, Land and Fresh Water Shells of North America, Pt. 3, 1865, p. 105, fig. 211. (Smithsonian Misc. Coll. No. 144.) Cited from Mazatlan as well as farther south.

Neritina usurpatrix Crosse & Fischer, Jour. de Conchyl. vol. 40, no. 3, 1892, p. 293. A new name for *Neritina picta* Sowerby, not *Neritina picta* Férussac (G. P. Deshayes in A. E. Férussac, Hist. Gener. et Part. Moll. Livr. 20, 1823. [On wrapper of Livr. 20, according to Sherborn, Index Anim.], figs. 4-7). —— Crosse & Fischer, Miss. Sci. au Mexique, et dans L'Amérique Centrale, Pt. 7, Moll. vol. 2, 1900, p. 486, pl. 58, figs. 7, 7a, 7b, 7c, 7d. Mazatlan, Mexico to Guayaquil, Ecuador. [Guayaquil record by Wolfe].

Nerita picta Sowerby, Pilsbry & Lowe, Proc. Acad. Nat. Sci. Philadelphia, vol. 84, 1932, p. 127. "Mazatlan; La Paz; Guaymas: Gulf of Fonseca: Puntarenas; Salina Cruz."

Specimens referred to this species are present in the Hemphill collection from the Pleistocene of San Ignacio Lagoon, Lower California. The shells retain traces of the striped and zig-zag color markings, which are so noticeable on the living specimens. The species has been reported from the Gulf of California to Guayaquil, Ecuador.

Crosse & Fischer pointed out that Férussac had used the name *Neritina picta* and therefore they renamed Sowerby's species *Neritina usurpatrix.*

Vitrea indentata Say.

Helix indentata Say, Jour. Acad. Nat. Sci. Philadelphia, vol. 2, 1822, p. 372. —— Binney, Terrestial Air-Breathing Mollusks of the United States, vol. 2, 1851, p. 242, pl. 29, fig. 2. "Inhabits the northern, north-eastern, middle, and western states, and is probably a wide-spread species."

Vitrea indentata Say, Dall, Proc. Calif. Acad. Sci. Ser. 4, vol. 15, no. 15, 1926, p. 483. Maria Madre and Maria Magdalena Islands. Recent. Also Recent from Canada to Texas and southward to the Federal district of Mexico.

R[*etinella*] (*Glyphyalinia*) *indentata indentata* (Say), H.B.Baker, Proc. Acad. Nat. Sci. Philadelphia, vol. 82, 1930, p. 209. "Type locality: Harrigate and New Jersey," and eastern states.

This interesting species is present in the Pleistocene collection from Maria Madre Island. It also occurs Recent on this Island where it has been recorded by Dall. The species is quite widely distributed in North America, where it has been reported from the eastern and middle western states and from Canada to the Federal district of Mexico.

Plate 21

Fig. 1. *Calliostoma palmeri* Dall; plesiotype No. 6047 (C. A. S. type coll.), from San Ignacio Lagoon, Lower California; Henry Hemphill collector; Pleistocene.

Fig. 2. *Calliostoma palmeri* Dall. Basal view of specimen shown in figure 1.

Fig. 3. *Odostomia gallegosi* Hertlein, new species; holotype No. 6059 (C. A. S. type coll.); altitude 4.5 mm., diameter 1.8 mm.; from Loc. 1836 (C. A. S.), along the beach cliffs about the middle of the north shore of Maria Magdalena Island, Tres Marias Group, Mexico. G. D. Hanna and E. K. Jordan collectors; Pleistocene.

Fig. 4. *Eunaticina heimi* E. K. Jordan, new species; holotype No. 5557 (C. A. S. type coll.). Altitude 9.6 mm.; width of body whorl 7 mm.; from Loc. 754 (C. A. S.) Magdalena Bay, Lower California; G. D. Hanna and E. K. Jordan collectors; Pleistocene. This species is present at Loc. 1834 (C. A. S.), Maria Madre Island, Mexico; Pleistocene.

Fig. 5. *Ostrea palmula* Carpenter; upper valve, plesiotype No. 6060 (C. A. S. type coll.) from San Ignacio Lagoon, Lower California. Henry Hemphill collector; Pleistocene. The specimens from this locality possess some characters in common with *O. angelica* Rochebrune, and might perhaps, be considered as falling within the variants of that species.

Fig. 6. *Glycymeris multicostata* Sowerby; plesiotype No. 6066 (C. A. S. type coll.) from Loc. 1834 (C. A. S.) about 215 meters inland at the Salt Works, on the east side of Maria Madre Island, Tres Marias Group, Mexico; G. D. Hanna and E. K. Jordan collectors; Pleistocene.

Fig. 7. *Ostrea palmula* Carpenter; lower valve; plesiotype No. 6061 (C. A. S. type coll.) from San Ignacio Lagoon, Lower California; Henry Hemphill collector; Pleistocene.

Fig. 8. *Ostrea palmula* Carpenter; view of the interior of the specimen illustrated in Figure 5.

Fig. 9. *Plicatula spondylopsis* Rochebrune; plesiotype No. 6068 (C. A. S. type coll.), from same locality as specimen shown in figure 3. This is an enlarged view of the interior of the specimen shown in figure 12.

Fig. 10. *Ostrea palmula* Carpenter; lower valve; plesiotype No. 6061-A (C. A. S. type coll.), from same locality as specimen illustrated in figure 5.

Fig. 11. *Chama squamuligera* Pilsbry & Lowe; plesiotype No. 6067 (C. A. S. type coll.), from same locality as specimen shown in figure 3.

Fig. 12. *Plicatula spondylopsis* Rochebrune; plesiotype No. 6068 (C. A. S. type coll.), altitude of figured specimen 12.5 mm., width 13.1 mm.; from the same locality as the specimen shown in figure 3.

Fig. 13. *Turritella marmorata* Kiener; plesiotype No. 5924 (C. A. S. type coll.), from San Ignacio Lagoon, Lower California; Henry Hemphill collector; Pleistocene. Specimen imperfect due to weathering.

Fig. 14. *Cardium obovale* Sowerby; plesiotype No. 6069 (C. A. S. type coll.), from same locality as specimen shown in figure 3.

All illustrations are approximately natural size except where dimensions are given. Photographs of the specimens were made by G. D. Hanna, A. Christofferson and W. M. Grant.

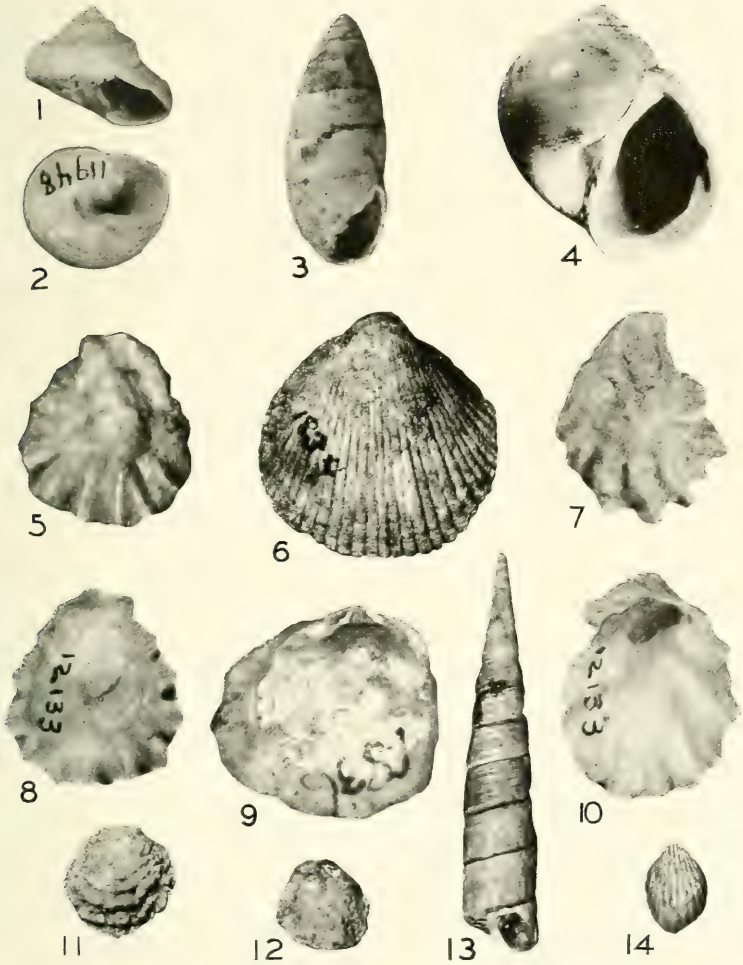

PLATE 21

TWO NEW MICROLEPIDOPTERA FROM CALIFORNIA

By August Busck
Bureau of Entomology, United States Department of Agriculture

The United States National Museum is indebted to Commander C. M. Dammers of Riverside, California, who for several years has sent to it large collections of Microlepidoptera, many carefully reared with notes on foodplants. These Micros were collected incidental to Commander Dammers' work with other California Lepidoptera, which has added so much to the knowledge of the early stages, through his enthusiastic collecting and his successful mating and breeding of the insects in captivity.

Several new species have been received in these sendings, besides good series of many described species much needed in the National Collection. Because of the excellent descriptive work on California Microlepidoptera by H. H. Keifer of the California Department of Agriculture, who deposits type material of all his new species in the National Museum, where they are safe and freely accessible to future students, it seems desirable to leave this descriptive work largely to him. Hence I have selected to describe at present only the following two reared species, which are of special interest and for which Commander Dammers should receive first credit.

Aristotelia rhoisella, new species

Second joint of labial palpi light pink, with base and an ill-defined annulation near tip black; terminal joint longer than second, light ochreous, with two broad ill-defined black annulations. Tongue long, scaled, ochreous. Antennae black with a white annulation on each joint. Face light ochreous, touched with pink. Head and thorax light pinkish fuscous, mixed with ochreous. Fore wings with typical pattern of the *roseosuffusella* group; costal two-thirds pinkish white, sprinkled with black; dorsal third light ochreous, touched with pink, especially along terminal edge; near base an outwardly oblique costal streak, reaching to the dorsal ochreous third; at basal third a similar outwardly oblique costal streak, reaching to the dorsal area and curving upwards attenuated towards a large ill-defined black costal spot at apical third; after this spot the white ground color on costa is nearly unmixed with black scales and strongly touched with pink. This light costal area is represented on the otherwise dark fuscous underside by a light ochreous costal spot; at the end of the cell is a round ochreous spot extending from the dorsal ochreous area into the costal area; this spot is preceded and followed by black scales, which form an interrupted longitudinal streak; cilia yellowish fuscous, touched with pink on base; underside dark fuscous, in the male with the scales blacktipped on all ill-defined

and not conspicuous basal area. Hind wings light silvery fuscous with yellowish cilia. Abdomen light fuscous above; underside of body ochreous white. Legs blackish fuscous with rose-colored annulations on tibia; spurs light ochreous; tarsal joints black with narrow ochreous annulations.

Male genitalia (pl. 22, figs. 1 and 1*a*) typical of the genus; uncus stout, bluntly pointed; gnathos as long as uncus, gently curved, bluntly pointed; harpes divided*, with upper arm long, slender, slightly broadened and rounded at tip, lower branch short, deflected, blunt; vinculum broad, with anterior extension rounded; aedoeagus short, bulky at base, with narrow, convoluted apex; female genitalia (pl. 22, fig. 2) with simple, not protruding ostium; ductus bursae rather long and not curved upon itself, as commonly is the case in the genus; bursa oval with small triforked signum.

Alar expanse 12-13 mm.

Habitat—Coachella Valley, California (C. M. Dammers).

Foodplant—Rhus.

Type—No. 50503, U. S. National Museum.

The species is important in helping clear up a query of seventy years' standing. As pointed out by the writer in the Revision of North American Gelechiidae (Proc. U. S. Nat. Mus., vol. 25, p. 796, 1903) the name *roseosuffusella* Clemens was until then and has been since applied to the common *Trifolium*-feeding species. But Clemens expressly stated that *roseosuffusella* feeds on the fruit of sumach (Proc. Ent. Soc. Phila. III, p. 508, 1864) and there has consequently been an uncertainty about the identity of the species; every year the writer has gathered fruit panicles of *Rhus* in various localities in an effort to rear an *Aristotelia* which would conform with Clemens' description, but without avail. When the present species, reared from *Rhus,* was received from Commander Dammers the old question seemed to be solved. Clemens never gave any locality for his new species, but it is known that while most of these undoubtedly originated from his own collecting in Pennsylvania, he did receive several specimens for description from other parts of the United States, including California, through the Smithsonian Institution.

However, to settle the matter permission was asked to make genitalia slide of Clemens' type in the Philadelphia Academy of Natural Science and this permission was liberally granted by the Curator, Dr. James A. G. Rehn.

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* The harpes in the genus *Aristotelia* are divided, as is the rule in the family Gelechiidae; Forbes' figures of several species of the genus (Journ. N. Y. Ent. Soc., vol. 40, pl. 20, 1932), while helpful, are not sufficiently accurate to enable safe differentiation of the many closely similar species of this genus, and the lower arms of the harpes are either omitted or represented as part of the vinculum.

These genitalia (pl. 22, figs. 3 and 4) prove beyond dispute that the name *roseosuffusella* Clemens must be retained for our common *Trifolium*-feeding species and that Clemens' statement of foodplant, which was made four and a half years after he described the insect, was an error, possibly occasioned by his obtaining a specimen of the present species reared from *Rhus* and not differentiating between these two similarly colored species.

The species of the *roseosuffusella* and *rubidella* groups of *Aristotelia* are with few exceptions difficult to determine from coloration alone and no additional species should be described except when the foodplant is known.

The genitalia of both sexes, however, though also very uniform in general pattern, present good definite characters. The writer has genitalia slides of both sexes of all available American species of the genus and good figures have been made from them, which enable ready specific recognition.

Plutella dammersi, new species

Labial palpi light yellow; second joint sparsely sprinkled with black on outer side; terminal joint as long as tuft on second, slightly thickened with scales in front. Maxillary palpi short, porrected, yellow. Tongue long, spiraled. Antennae ¾, strongly thickened with scales on basal half and with well developed flap on basal joint; light yellow, terminal joint black, preceded by two white joints, then two black joints, again preceded by two white joints, before which three black joints and a fourth particularly black. Face and head whitish ochreous. Thorax darker ochreous. Fore wings concolorous with thorax, in most specimens before me entirely unmarked; in some with a few scattered deep black scales along dorsal and terminal edge; cilia concolorous. Hind wings dark shiny fuscous with lighter fuscous cilia. Abdomen dark fuscous above. Underside of body light silvery ochreous. Legs white sprinkled with black scales. Venation typical of the genus; fore wing with 12 veins all separate; 7 to termen. Hind wings with 8 veins, 3 and 4 closely approximate, 5 and 6 approximate; 7 parallel to 6.

Male genitalia (pl. 22, figs. 6 and 6*a*) typical of the genus, but specifically very distinct; uncus and gnathos absent; the long soft anal tube supported by a long slender ventral plate; socii short, triangular, projecting; harpes elongate oval with costal edge and sacculus slightly chitinized; sacculus ending in a strong free spine underneath which is a small tuft of flattened spines; an abrupt sinuation on cucullus, just above the strong terminal spine on sacculus; vinculus small with short blunt anterior prolongation; aedoeagus slender, slightly curved, with slightly swollen base. Eighth segment in the male ending in two free lobes, enclosing the genitalia and with two long expansible hair tufts, at rest withdrawn in deep pockets.

Female genitalia (pl. 22, fig. 5) with short pointed ovipositor lobes, ostium simple; ductus bursae abruptly bent near ostium, short, simple; bursa small, without signum.

Alar expanse 14-17 mm.

Habitat—Whitewater and Rattlesnake Canyon, Mojave Desert, California (C. M. Dammers).

Foodplant—Isomeris arborea.

Type—No. 50253, U. S. National Museum.

The open net-work, pure white cocoon is typical of the genus.

Named in honor of the industrious collector, Commander C. M. Dammers, who has kindly presented to the National Collection the type series of this species and many other reared and beautifully set Lepidoptera.

The species is at once recognized by the strikingly-colored and thickened antennae. In color it approaches the paler *Plutella armoraciae* Busck, (*P. monochlora* Meyrick), injurious to horse-radish in Colorado.

The foodplant record of *Plutella dammersi* is interesting; most of the species of this genus are confined to the Cruciferae; there are only two previous records of *Plutella* feeding on other plants and both of these on the related family Capparidaceae, to which the monotypic California genus *Isomeris* belongs. J. C. Bridwell found the larvae and reared the moths of two species of Hawaiian *Plutella, P. albovenosa* Walsingham and *P. capparidis* Swezey, feeding on the endemic Hawaiian capers, *Capparis sandwichiana* (Proc. Hawaii Ent. Soc., vol. 4, pp. 316 and 383, 1919).

Explanation of Plate 22

Fig. 1. *Aristotelia rhoisella* Busck, male genitalia.

Fig. 1*a*. *Aristotelia rhoisella* Busck, aedoeagus, same scale as Fig. 1.

Fig. 2. *Aristotelia rhoisella* Busck, female genitalia.

Fig. 3. *Aristotelia roseosuffusella* Clemens, male genitalia.

Fig. 3*a*. *Aristotelia roseosuffusella* Clemens, aedoeagus, same scale as Fig. 3.

Fig. 4. *Aristotelia roseosuffusella* Clemens, female genitalia.

Fig. 5. *Plutella dammersi* Busck, female genitalia.

Fig. 6. *Plutella dammersi* Busck, male genitalia.

Fig. 6*a*. *Plutella dammersi* Busck, aedoeagus, same scale as Fig. 6.

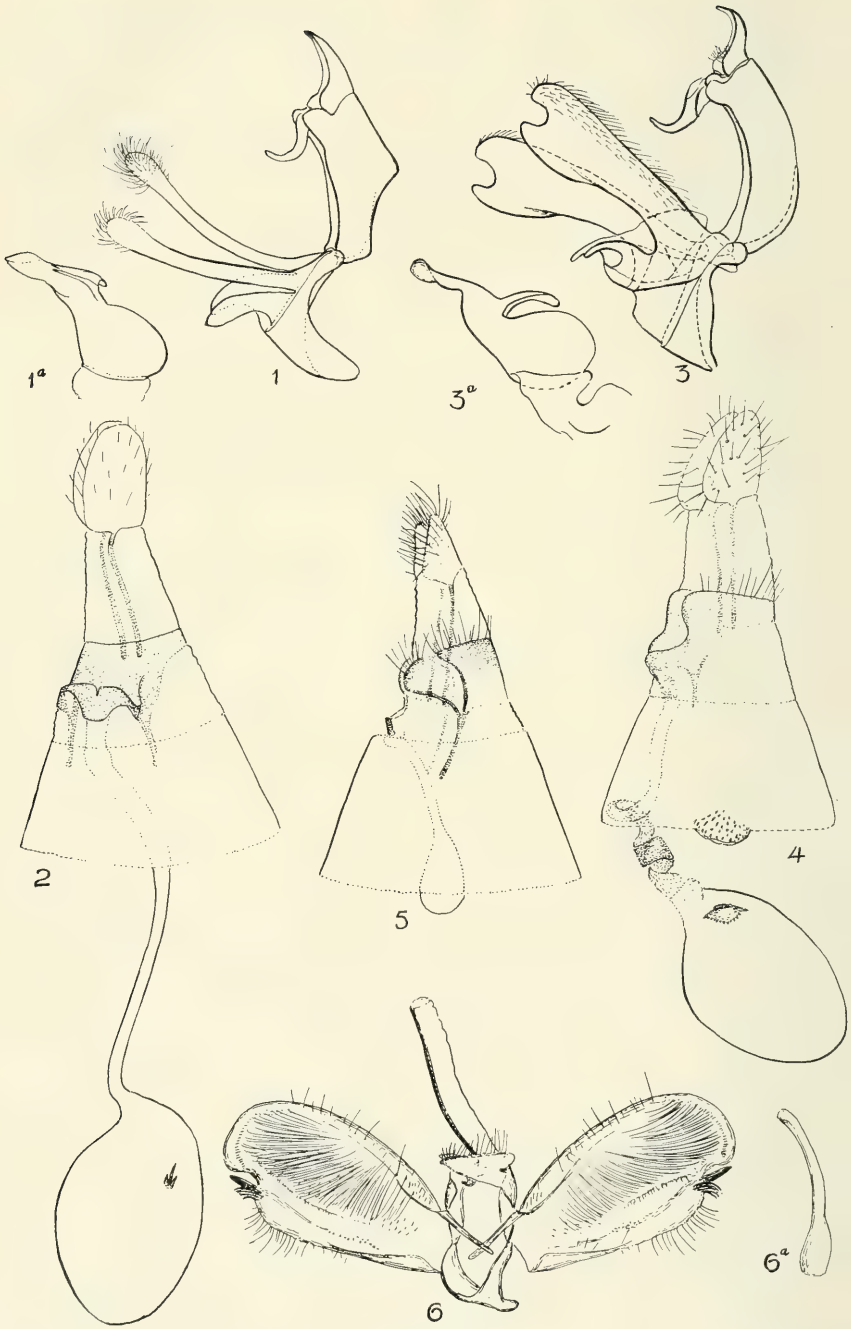


PLATE 22

THE METAMORPHOSES OF THREE CALIFORNIA DIURNALS

By John A. Comstock and Charles M. Dammers

Strymon auretorum spadix Hy. Edw.

This butterfly has, until recently, been considered one of our rare species. Rarity, however, seems largely a question of time and place. If one finds the real metropolis of a species, at a time when climatic and thermal conditions are at their best, that species will appear in abundance.

This was demonstrated in July of 1933, when the junior author found an immense colony of *S. spadix* on the wing, in the oak belt, at the top of Cajon Pass in the San Bernardino Mountains.

A search in this region led to the discovery of the eggs, and later additional numbers were secured from a captive female. On April 25th of this year larvae were collected in the same territory. This made possible the following somewhat incomplete life history.

Egg. Echinoid, the body color mauve, covered with long green spicules. Micropyle, large, and deeply depressed. When fresh, the entire egg is a brilliant green.

The female deposits her eggs singly, on the stems of oak. Undoubtedly these overwinter, and the young larvae emerge in the spring. The egg is illustrated on Plate 23.

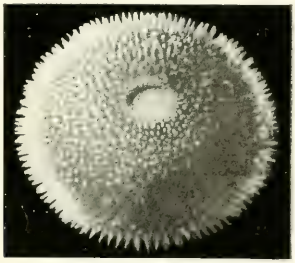


PLATE 23
Egg of *Strymon auretorum spadix*
highly magnified.
Drawing by Comstock

Mature larva. Length, extended, 16 mm. Slug shaped. The color varies from an apple green to pale orange.

The green form may be described as follows:

Body, apple green, covered with soiled white punctae from which arise short orange-chestnut hairs. The infra-stigmatal fold is soiled white, and in some examples its lower edge is laved with pale magenta.

Spiracles, soiled white, with brown rims. Legs, pale green with colorless tips. Prolegs, pale green with pink claspers.

Abdomen slightly paler than the dorsum, and covered with colorless hairs.

A well defined cervical shield is present. This is pale mauve, and is covered with chestnut hairs, as shown on Plate 24.

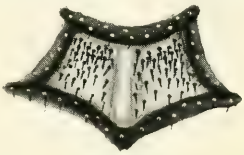
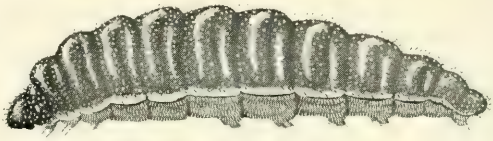


PLATE 24
Cervical shield of larva of *Strymon auretorum spadix* highly magnified.
Drawing by Dammers

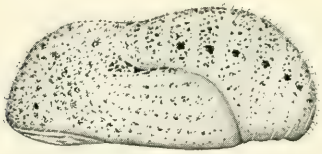
Head, dark brown.

This dark form of the larva is illustrated on Plate 25, fig. A.

The pale orange form varies from the above in the following particulars:



a



b

c

PLATE 25
Larva and pupa of *Strymon auretorum spadix*.
a. Mature larva x 4. *b*. Pupa, lateral aspect x 4.
c. Pupa, dorsal aspect x 4.
Drawing by Dammers

Body color, pale orange. Infra-stigmatal fold lemon-white. Abdomen, somewhat lighter than the dorsum. All legs and prolegs, colorless.

In examples reared in the laboratory pupation took place from April 30th on, the chrysalis being formed on the foodplant, supported by a silk girdle.

PUPA. Length, 11 mm.

The color of the average specimen is a pinkish buff, but some examples have this color on the body only, the remainder being a soiled white.

On the head and first two abdominal segments in the median dorsal line there is a narrow dark brown line, as shown on figure C of Plate 25. On the next segment posterior thereto is a triangular spot of the same color. Dorso-laterally on the body occurs a longitudinal row of round spots of the same color, one to a segment.

The head, thorax and wing cases are sparingly sprinkled with dark brown spots of varying sizes.

Spiracles, soiled white.

The head, thorax and body are covered with short pale buff hairs.

Imagos emerged from May 14th on.

MEGATHYMUS STEPHENSI Skinner.

One of the rarest diurnals of California is *Megathymus stephensi,* a species which was discovered by and named for the pioneer naturalist of San Diego, Frank Stephens.

It had long been our hope to work out the metamorphosis of this species, but not until 1932 were our efforts rewarded with success. Mr. W. G. Wright of San Bernardino, confusing the species with *Megathymus neumoegeni,* states that the larvae "feed upon the pith inside the stems of Yucca deserti," which is evidence that he had not seen the caterpillar, and had probably mistaken the burrows of a beetle for those of the Yucca borer.

Our studies of the habits of the imago, and its restricted range, corresponding to that of *Agave deserti,* led us to conclude that it was an Agave feeder. On Oct. 8th, 1932, a trip was made to the vicinity of Mason Valley (La Puerta), San Diego County. A large number of Agaves were examined, and sections were made of entire plants, including the central stalk, root, and fruit. No evidences of tunneling by Megathymus were found, but the burrows of the black beetle, *Scyphophorus yuccae* Horn., were abundant in the seed stalks.

Finally larvae were discovered in the fleshy leaves, securely hidden in excavated chambers. These chambers were invariably located in the lower fourth of the leaf, and averaged in measurement about 70 mm. long. The upper expanded portion of the chamber averaged 20 to 30 mm. wide and the lower portion measured about 10 mm. These measurements were made on chambers containing mature larvae or pupae.

The leaves which were infested showed no damage at the tips, and were always situated near the outer circumferance of the plant.

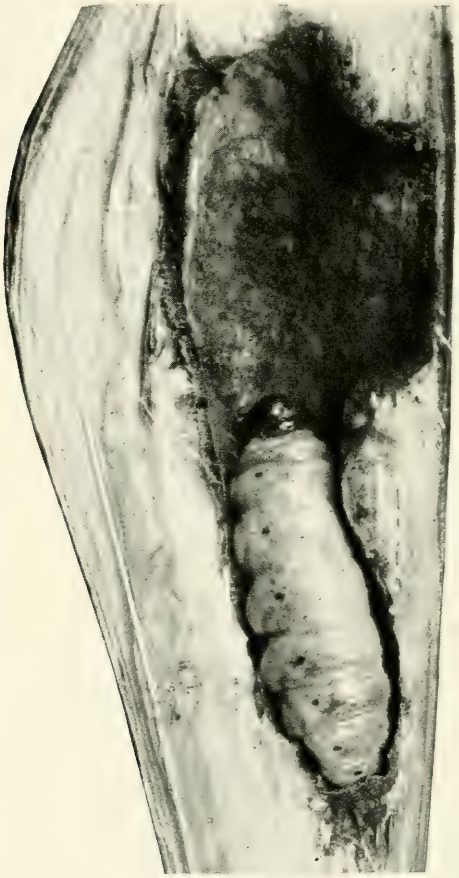


PLATE 26
Mature larva of *Megathymus stephensi* at rest in its chamber.
Photo by Menke

The burrows communicate with the exterior on the upper (inner) surface of the leaf, by means of a minute opening, which is difficult to locate as it is nearly obscured by the opposing leaf above. The presence of larvae can be detected by the frass thrown out through this small aperture.

A cross section of a larval chamber, with a fully grown caterpillar within it, is shown on Plate 26.

When the larva is ready to pupate it enlarges the opening and weaves a covering of silk in such a manner as to insure the removal of this door intact, with sufficient space for the imago to emerge. The silk is not split on emergence, hence there are no rough edges to interfere with egress. Instead, the pressure of the imago springs open the door, as though it were neatly hinged. Plate 27 pictures this open doorway after the imago has escaped. Thus it is noted that an engineering instinct must guide the larva at the time it spins this doorway, which allows for a circle of

PLATE 27

Doorway in Agave leaf, through which the imago of *Megathymus stephensi* has emerged from its pupal chamber.

Photo by Menke

weakness sufficient in diameter to enable the imago to escape,—yet stout enough to protect the pupa and keep out inquisitive visitors.

Pupation occurs from about August to early October, and the imagos emerge shortly thereafter.

The act of oviposition has not been observed, and eggs have never been found on any portion of the Agave plant. Females have been seen resting under the plant, and a captive female perched on the side of a breeding cage in which two Agaves were enclosed laid several eggs by snapping or flipping them off singly, turning her tail from side to side as each egg was expelled. These eggs rolled to the floor of the cage. They bore no adhesive covering.

From this it is surmised that the eggs are not fastened to the plant, but are expelled or "flipped" into the Agaves, and rest on the ground or at the bases of the plants, from which locus the young caterpillars crawl up the leaves and burrow in. Further observations should be made in the field, to determine this point. The young caterpillars mature slowly, reaching full growth the following year. Hence there is but one brood in a season.

The eggs secured from our single captive female were fertile, and developed larvae which, for some unknown reason, were unable to escape the shell. We therefore cannot, at this time, record the young larvae, but hope later on to fill in this gap in our knowledge of the metamorphosis. The following description is consequently somewhat incomplete.

Egg. Hemispherical. Base, flat, and slightly cupped in the center. Sides rounded. Color, blue-green when first laid. After the second day it becomes blotched with red. Size, 1.75 mm. in diameter, by 1.25 mm. high. A large shallow micropyle is conspicuous at the apex. The texture appears to be smooth and shiny, but under high magnification the entire surface, including the micropyle, is seen to be finely granular. See Plate 28.

PLATE 28
Egg of *Megathymus stephensi*
magnified x 25.
Drawing by Comstock

Mature larva. Extended length 40 mm. in the single example that was measured. This specimen had a transverse diameter of 7.5 mm. at the 6th segment.

Body, fleshy, thickest at 6th segment, tapering sharply towards the head, and less acutely caudally. Color, soiled ivory, with a suggestion of blue-green showing through. The latter is particularly marked from the 8th to the 10th segment. There is also a

concentration of this greenish color in the mid-dorsal line from the 8th to the 10th segments, suggesting an incomplete mid-dorsal band.

There is a prominent black scutellum developed on the first segment, measuring about 3.5 mm. in length x .3 mm. wide.

The caudal segment is somewhat rugose, and is pale brown shading to olive-brown on its anterior half.

Abdomen concolorous with body. Legs, pale brown.

Prolegs concolorous with body, the claspers black.

Spiracles oval, large, conspicuous, and blackish brown.

Head, pale brown, sparingly covered with short yellowish-brown hairs. The surface is finely granular. The segmental lines separating lobes and clypeus are slightly lighter in color than the contiguous parts.

Ocelli, minute, dark brown. Mouth parts, dark brown, particularly the mandibles which shade into blackish-brown. The head is small in comparison with the body, measuring about 3 mm. from crest to mouth, and about 2.65 mm. from side to side.

The entire body of the caterpillar is covered with minute brownish pile, discernible only with a lens. A pair of these hairs on the dorsum of each segment are much elongated, and a number of hairs are particularly well developed and thickened over the caudal segment. See Plate 29.

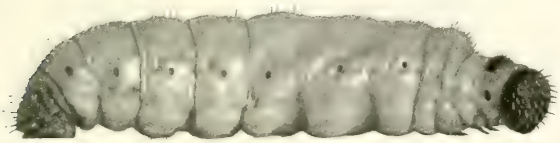


PLATE 29

Mature larva of *Megathymus stephensi* enlarged x 1¾.
Photo by Menke

As the larva reaches maturity it produces, in some unknown manner, a soapy or flaky white material, composed of small white platelets, resembling pads of silk, with which it lines the interior of the burrow, and also covers itself. At this period it rests in the lower portion of the burrow with its head toward the opening. Pupation occurs at this site. The larvae are heavily parasitized by *Apanteles megathymi*.

Pupa. (Male) length 30 mm.

Stout, cylindrical, the thorax relatively short and only slightly protruded. Wing cases reaching to the middle of the fifth abdominal segment. Segmental junctures clearly defined. Ocelli prominent.

Color, greenish yellow, sparingly speckled with indistinct mauve. Segmental lines, pale chestnut. Spiracles pale chestnut, as is also the cremaster.

Thorax and wing cases, soiled amber, with a slight tinge of green on the prominent portion of the thorax.

Head, including ocelli, and antennal sheaths, amber.

There is an irregular dull green mid-dorsal line.

On magnification the head, thorax and body are seen to bear short pale brown pile. The white flaky material above described also covers the surface of the chrysalis.

The pupa is accurately pictured on Plate 30.

a. *b.* *c.*

PLATE 30
Pupa of *Megathymus stephensi* enlarged x 2.
a. Ventral surface. *b.* Lateral surface. *c.* Dorsal surface.
Photo by Menke

One interesting point that needs further study is in connection with the feeding habits of this larva. When the chamber is cross sectioned it is seen to be lined throughout with a brown fibrous material suggestive of masticated pith. On the inner surface of this lining is a delicate covering of silk. Evidently the larva removes some of this lining each time that it feeds, and replaces it immediately after feeding. Thus it insures against secretion or exudation by the plant of a viscid gum, which is produced as a repair process, and the prescence of which in a burrow would soon render it untenable.

MEGATHYMUS YUCCAE NAVAJO Skinner.

This giant skipper has been taken sparingly for many years in the California deserts. Captures were usually recorded in the Joshua Tree belt, and it was surmised that this yucca was its preferred food-plant. Search was repeatedly made by entomologists for a number of years, in an effort to locate the larvae, but results were negative.

It was due to a chance observation of Charles Dammers, Jr., that the secret was revealed. He noted a female hovering over a young shoot of the Joshua Tree, and watched it until the egg was laid.

This fantistic Yucca, *Y. brevifolia* Engelm., is propagated principally by means of shoots which spring from the long cylindrical roots thrown out from the parent tree. In favorable years or locations, these shoots may sprout in considerable numbers. The leaves of these young shoots are semi-succulent, whereas the older leaves of the parent tree, and shoots of more than two years growth are too hard to allow of penetration by the young larva.

The young shoots are therefore chosen by the female as the site of oviposition. Occasionally a shoot is produced at the base of the tree, and such growth also furnishes sufficiently tender leaves to attract the ovipositing female.

Eggs have also been found on the tender leaves of *Yucca mohavensis* Sarg. and in the Charleston Mts., Nevada, a third species somewhat resembling *Yucca glauca* (not positively identified) yielded the larvae.

In normal years the imagos are on the wing in March and April. The females are occasionally observed in the Joshua groves, flipping along close to the ground. The males seem to prefer dry washes, where they frequently alight on the sand in the centre of the wash to sun themselves. If disturbed they fly upward with great rapidity, but may later return to the same spot.

Occasional seedlings of the Joshua are found, though they are surprisingly scarce in comparison with the shoots. These seedlings are seldom infested, as their roots are not sufficiently large to accommodate the burrowing larva.

Eggs are laid singly, and in the majority of cases there is only one to a plant. However, plants have been observed carrying as many as five. Only one larva can be accommodated on a single shoot.

The eggs hatch in about 18 days, and the young larva burrows into the base of a leaf and usually consumes the heart of this before working into the root. Thereafter it works in the root, continually enlarging and extending its burrow. The top of the plant soon dies, and as the larva continues to grow it builds an

upward extension of its burrow into an elongate elliptical chamber, composed of silk, on the outer surface of which is incorporated some of the frass. This gives the chamber a brown encrusted appearance. The caterpillar is careful not to soil this chamber, or any portion of its burrow. During the act of excretion it first moves upward into the chamber, cuts an opening, and,

PLATE 31

Young larva of *Megathymus yuccae navajo* much enlarged.

PLATE 32

The burrow of larva of *Megathymus yuccae navajo* in young shoot and a portion of the root of the Joshua tree. About ½ natural size.

Photo by Menke

if there are spicules of the plant within reach, cuts these off. It then returns to its burrow, turns around, and backs up to the opening. After depositing the frass, it returns to the burrow, turns around, and comes up head first, to close the opening with silk.

The larva ceases feeding about the middle of September, and begins to cover itself and the inner surface of its burrow with a flaky white substance. The purpose of this, and the method of its production, are unknown. It may perhaps serve partly as a waterproofing, and as a medium allowing free movement of the pupa throughout the burrow.

This flaky substance, when moved between closed finger and thumb, has a soapy or slippery feeling, whereas the surface of the silk-lined burrow is of a nature that might offer resistance to movement. The waterproofing properties are surmised from the fact that the larva of *Megathymus stephensi* produces the same flaky substance. In the latter case there is no long burrow to be transversed. Instead, there is a succulent pith in which the burrow is formed. It is noted that this burrow is always dry and free from mould, whereas the surrounding pith of the agave is heavily impregnated with moisture.

The mature larva of *M. yuccae navajo* over-winters in its burrow, and pupation does not occur until January or February. A number of larvae were collected in late February, but practically all of them were parasitized and did not reach the pupal stage.

The pupa usually rests in the elliptical chamber at the upper end of its burrow. If disturbed it backs downward with great rapidity, but later returns to the chamber. This movement may be observed repeatedly with the same individual.

The larval burrow usually traverses the root of the shoot down to its juncture with the main root. Frequently it will enter the main root. The average length of the burrow is about 12 inches, but in slender roots it may extend for a much greater distance.

Infestation occurred on Yuccas at the lowest altitude in which they grow, up to the snow line. The butterfly seems to prefer groves that are situated in foothill canyons. Infestation is least abundant on the open flat deserts.

This Megathymus is apparently able to adapt itself to widely varying environments. In Prof. Riley's description* of the parent species, *yuccae*, it is reported as burrowing two feet underground, in the roots of *Yucca alifolia* and *Y. gloriosa*. The elliptical chamber is described as being formed partly of the leaves, united with silk. One specimen reared in our laboratory, when placed on *Agave deserti* Engelm., worked for some time between the surfaces of opposing leaves, but was not able to reach the heart of the plant, and finally died. Probably it was unable to combat the heavy gum which this Agave exudes.

* Eighth Annual Report of the State Entomologist of Missouri, p. 169.

Professor Riley did not note that the "white glistening soapy powder" appeared only when the larva was fully matured.

Many of the fully grown larvae were transferred to tubes made of blotting paper. They lined these with silk, covered the upper opening and changed to chrysalids therein without any apparent objection to their new domicile.

Of fifty eggs collected in March, 1932, only three were raised to maturity. These were reared in a laboratory under abnormal conditions, in which the temperature was relatively uniform throughout the winter, and no moisture was furnished to the plants. They emerged Feb. 10, 1933. All were dwarfed. A second lot, bred under conditions more nearly simulating their native environment resulted in a larger hatch of more normal imagos. Best results were obtained by collecting full grown larvae in January and February, just prior to their pupation.

These latter emerged between March 14th and April 27th.

The species is heavily parasitized by *Apanteles megathymi* and by a Tachinid.

The following observations on the life cycle may help to supplement Professor Riley's excellent account.

Egg. Conoidal, with a depressed micropyle at the top. Base, flattened. Size, 3 mm. broad at the base, by 1.5 mm. high. Color, when first laid, bright blue-green or turquoise, changing to pinkish ivory, and finally to a pale brown. All of the examples observed by us showed a more acute cone with less curve or bulge on the sides than is depicted in Riley's illustration. Our photograph, Plate 33, was taken at an angle so as to show the micropyle, and does not bring out this feature of the acutely sloping sides.

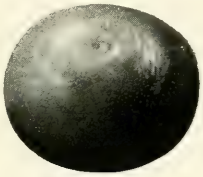


PLATE 33
Egg of *Megathymus yuccae navajo*
magnified x 8.
Photo by Menke

Larva, first instar. Length, extended, 8 mm. (Riley gives 6 mm.). Color, reddish, maroon, the abdomen slightly lighter. There is a black collar across the first segment. Legs, concolorous with body. Spiracles orange.

Head, black, with a sparse covering of short black hairs. The six longitudinal rows of hairs on the body are correctly described by Riley, but on our examples they were dark brown and not black.

A larva in the second, or possibly the third instar is shown on Plate 31.

Larva of 35 mm. in one of the intermediate instars may be described as follows.

Body, creamy buff, sparingly covered with short colorless hairs. A broad black scutellum crosses the top of the first segment. On the 5th segment, mid-dorsally in the center of the segment, there is a black spot. A similar spot occurs on the 6th segment at its juncture with the 7th. On the 10th segment at its juncture with the 11th there is a narrow black bar across the back. These latter three black markings were not observed on all examples.

The rear half of the caudal segment is dark chestnut. Spiracles, pale brown, encircled by darker brown. Abdomen concolorous with body, as are also the legs and prolegs. The hooks on the latter are dark brown.

Head, dark chestnut, sparingly covered with short colorless hairs. Ocelli, colorless, on dark bases.

Spinneret, white. Mouth parts, solied white.

Mature larva, length 45 to 57 mm.

The ground color is lighter, and is described by Riley as "edematous white." In other respects there is little change from the intermediate instar above described.

Many of the points noted by Riley do not need repetition here. His figure of the mature larva is somewhat more elongated than noted by us. Plate 34 shows an actual photograph of the larva in its last instar.

PLATE 34

Mature larva of *Megathymus yuccae navajo* enlarged about x 2.

Photo by Menke

Pupa (male). Length, 38 mm. The form, and special characteristics are accurately described by Prof. Riley, but he makes no mention of the pale brown spiracles, surrounded by short stout chestnut vibrissae. Our examples showed a gray coloration on the head, throat and wing cases, which Riley describes as brown-black. Plate 35 accurately pictures the pupa.

We are also showing, on Plate 32, a burrow formed in a young shoot of *Yucca brevifolia,* cut in cross section. The main root in this example was close to the surface, and the larva had excavated for some distance through it.

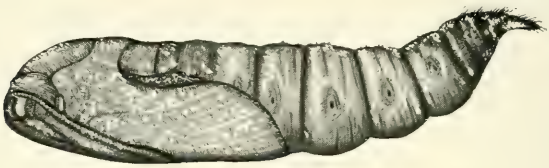


PLATE 35

Pupa of *Megathymus yuccae navajo* enlarged approximately x 2.

Drawing by Dammers

THE SOUTHERN CALIFORNIA PRICKLY-PEARS

By F. R. Fosberg

After observing and attempting to solve the complexities involved in the classification of the Platyopuntias in Southern California for the past six years I have come to the conclusion that the methods of taxonomic treatment used in ordinary plant groups will not give satisfactory results.

This is due in a large measure to two things. One is a purely human, psychological trait, that of attaching undue importance to characters that concern unusual or striking parts of a plant such as the armament and the enlarged stems of the cacti. The other concerns the cacti themselves. In ordinary plants, hybrids soon die out because of a very high or even complete sterility of the offspring and also because they are swamped in the enormous numbers of the parent species. In most cases hybrids do not even form in the first place. In cacti, and in the Platyopuntias especially, seed formation is not the only method of propagation. Any joint or part of the plant that happens to break off and fall to the ground or be carried to some other locality immediately takes root. A plant, hybrid or otherwise, may thus live in itself and in its vegetative offspring for a long time, and may spread for a long distance without ever producing a fertile seed. The resulting abundance of hybrids and descendants of hybrids makes the separation of groups of individuals with approximately the same combinations or morphologic and genetic characters practically impossible.

There is also much evidence, chiefly derived from the behavior of single plants and their cuttings under cultivation, that the group is to some extent in a condition of genetic instability. To this may be added the fact that herbarium specimens are extremely difficult to make, and when made are usually not very satisfactory. Compared with other groups there are extremely few specimens extant.

Much field study has suggested that the ancestral forms represented by any particular complex of hybrids may be determined by a study of many individuals with an analysis of the groups of characters represented and a comparison with those represented in other complexes in neighboring localities. In this way entities may be determined which have a definite geographical and altitudinal distribution and which usually may be found in more or less pure condition in some localities. At least plants may be found which externally in all obvious morphological characters represent these entities.

Names have been given to many of these entities when found in a more or less pure state, and to some not so pure. Subsequently these names have been widely and variously applied, and

it would be far better if all could be scrapped and new ones proposed. This, however, is not in accord with the principles of nomenclatorial stability and cannot be done. Therefore the names will have to be applied, as nearly as can be determined, to the forms for which they were originally intended.

More study of plants from other districts may tend to confirm the placing of Opuntia littoralis in a different group from the other prickly pears, substantiating the opinion of Britton and Rose, but I have not as yet found such evidence. The plants seem to hybridize with O. occidentalis with as much facility as do the other members of the series Phaeacanthae of Britton and Rose, to which O. occidentalis belongs. There seems no morphologic difference of sufficient importance to justify a separation. Mr. S. B. Parish, in Jepson's Manual of the Flowering Plants of California even reduces O. littoralis to a variety of O. occidentalis. It was described as a variety of O. Engelmannii, which is also of the Phaeacanthae. Its true status can only be determined by a complete study of both groups concerned. Meanwhile I shall, for the purposes of this paper, consider O. littoralis as belonging to the same group as the rest of the predominantly cismontane forms.

Opuntia basilaris, characterized by its almost spineless character, purplish blue color and bright magenta blossoms with thin tissue-like petals, O. ursina and O. erinacea with their long, hair-like spines are not generally considered prickly-pears and are not easily confused with the others and so far as I know never hybridize with them. Opuntia Treleasei seems to be merely a form of O. basilaris with a few spines in the areoles. It is never found in any locality where it might be confused with any of the others. Opuntia rhodantha is in an entirely different group and its range is far to the north. Its affinities seem to be with the great basin species. Opuntia chlorotica has a fleshy fruit and in some ways resembles the prickly-pears, but at Buckman Springs, San Diego County, and at the north base of the San Bernardino Mountains, the only places where I have seen it in company with members of the group under consideration, there was no evidence whatever of hybridization, and the plants are very easily distinguished. O. chlorotica has a pale, glaucous epidermis, slender, bright yellow, acicular, deflexed spines and a very erect habit. The only plant with which it might even possibly be confused would be O. littoralis in its erect forms, but these grow only near the ocean, while O. chlorotica is a plant of the mountain ranges in or near the deserts.

In the immediate vicinity of the coast from a short distance north of Santa Barbara to somewhere in Baja California, Opuntia littoralis is very easily distinguished, in more or less pure form, by its bright, translucent yellow spines. These are markedly subulate, narrowing rapidly at the apex, and usually decidedly

curved. The epidermis is bright green, while that of Opuntia occidentalis is glaucous. O. occidentalis seems to be the only other entity present in the immediate vicinity of the coast and it is considerably mixed with O. littoralis. It has straight, acicular spines with a dark brown base and a white, bonelike distal portion. Sometimes the brown color extends almost through the entire length. Mixtures almost certainly including O. occidentalis were observed by me on Santa Catalina Island, but the great preponderance there were O. littoralis. On Santa Cruz and Santa Rosa Islands only O. littoralis was observed. The material on the Coronados seems predominantly O. littoralis, but brownish spines on some plants suggested an admixture of O. occidentalis. The illustration of O. occidentalis on page 147 in volume I of Britton and Rose's Cactaceae (fig. 186) "from a plant collected on Santa Catalina Island, California, by Mr. S. B. Parish" is unmistakably O. littoralis. The spine form and general appearance are absolutely that of the latter species.

In the interior valleys O. littoralis is not present, but there O. occidentalis is mixed with two other things, Opuntia Vaseyi and the form called by Britton and Rose Opuntia Covillei. O. Vaseyi is most abundant along the foot of the San Gabriel and San Bernardino ranges of mountains, but extends down many of the important washes to places such as Santa Ana Canyon and El Monte. The other plant, which Mr. Parish has referred to O. occidentalis and which I take to be the extreme western representative of O. phaeacantha, has a larger range, over most of the interior canyons and valleys in the cismontane upper Sonoran zone. The great majority of plants found in the regions where these forms occur together are a confusing mass of varying hybrids or descendants of hybrids whose composition may only be approximated by a careful analysis of the evident characters which can be referred to one or another of the three possible parents. A short, thick fruit, not more than twice as long as thick and not contracted at the base to any extent is a characer belonging to O. Vaseyi. Short whitish spines, less than two cm. long are also characteristic of this species, as is also a prostrate habit with erect branches. The joints of O. occidentalis are oblong, usually rather narrow, while those of the other two forms are obovate to almost orbicular. Very long red-brown spines, three to six cm. are characteristic of the phaeacantha group. They are usually twisted one half turn near the middle, round above the twist and somewhat flattened below it. In the variety Covillei the longest spines are practically all porrect. The flowers of O. Vaseyi are a pronounced salmon pink while those of the others are yellow sometimes tinged with or turning a light pinkish. Thus a plant such as is common around Claremont, with a prostrate habit, erect branches, obovate joints, 3 dm. long, short downward pointed spines of a red-brown color, yellow flowers and elongate fruits could be said to have all three forms in its ancestry.

In the higher ground from 1200 to 2200 meters, especially on the desert slopes of the mountains is another variety of O. phaeacantha, apparently undescribed, for which I will suggest the name Piercei, the description following later in this paper. I have observed this plant at San Felipe Canyon and Warner's Ranch in San Diego County, Baldwin Lake, Cactus Flats and Horsethief Flats in the San Bernardino Mts. and at Camp Baldy, San Antonio Canyon in the San Gabriel Mts. I have seen specimens which seem to be of this identity brought in to the Los Angeles Museum by Mr. Fisher, some growing and some preserved, collected in Mint Canyon, San Gabriel Mts. without definite locality stated. Mr. Baxter has referred this plant to Opuntia mojavensis in his article in the Journal of the Cactus and Succulent Society, V. 3, p. 101, December 1931, giving its distribution as the canyons of the desert side of the San Gabriel Range. O. mojavensis is, however, quite a different plant. O. phaeacantha var. Piercei is a plant of almost prostrate growth, with joints from obovate to orbicular or rhombic, usually less than fifteen cm. long, with spines very long, erect on the edges of the joints and reflexed on the sides, red-brown but at high altitudes becoming whitish. This plant has usually been referred to O. covillei. Below the range of the variety Piercei, in the actual desert in the lower parts of canyons from Arrastre Creek on the north slope of the San Bernardino Mts. around the edge of the deserts to at least as far as San Felipe Valley, is a plant which Dr. Griffiths has described and named Opuntia megacarpa. It seems referable to O. Engelmannii, although the fruit is somewhat different from that species. It is at least varietally distinct on the basis of the fruit, which instead of being short and obovate is rather long, up to eight cm. and cylindro-ellipsoidal, with a much deeper umbilicus. Its spines are very stout, white, with a brown base, flattened and up to three cm. long, at times even more. They are widely spreading, but not truly reflexed. The plants are ascending to almost prostrate and the joints are sometimes as much as thirty cm. long, and very light green. At Horsethief Flats on Arrastre Creek and in San Felipe Valley, the two places where I have observed the ranges of this plant and of O. phaeacantha var. Piercei coming together, there innumerable variations and different combinations of the characters of the two forms. This is one of the strongest evidences for the existence of hybridizing complexes of species in this group. Where only one form is present there seems to be comparatively little variation.

Opuntia mojavensis Engelm. is, so far as I can find out, known only from three collections, the type collection from "the Mojave Desert west of the Colorado," the only one known to Britton and Rose and previous authors, a collection from near Bonanza King Mine, Providence Mts., by Dr. P. A. Munz, May 21-24, 1920, and a plant collected by Mr. Wright M. Pierce on the Searchlight Road in California close to the Nevada boundary.

This latter plant is growing very healthily in Mr. Pierce's garden, fruiting abundantly last year. It is quite obviously another variety of O. phaeacantha. It differs in its more angular spines with little tendency toward being deflexed, yellowish brown in the upper parts. It also differs from the other varieties in California in its much larger joints. They are orbicular to elliptical and up to thirty cm. long.

The entities in this group have been disposed of as seems most logical in the present state of my knowledge of the group. This is by no means final. In fact, no pretense is made that this is anything but a temporary disposition to make usable the entities that I have been able to distinguish and which, I think, fairly well cover the group in Southern California.

For a year or two, perhaps more, I will be unable to continue my studies of this group, and I think that a preliminary treatment of the California representatives will enable students to make at least tentative identificaions of the plants in their localities. It may also give a suggestion of a method of study for students of similar groups in other localities. I hope in the near future to be able to continue these studies and to extend their scope to include a much wider range and to other groups of Opuntias.

The following is a key to the fleshy fruited Platyopuntias of Southern California. The first three, which belong to different groups, are included in the key to avoid possible confusion, but are not described or treated in any way in the text following.

Very large plants, 1.5 to 4 m. tall with large joints, 20 to 50 cm. long, usually erect and arboreous, not very spiny, introduced.

Spines brownish, fruit 8-11 cm. long, yellow to red, umbilicus broad and shallow .... *O. megacantha Salm-Dyck*

Spines whitish, fruit 5-8 cm. long, purple, umbilicus deeply depressed ..... *O. ficus-indica Mill.*

Plants up to 1.5 m. tall, joints usually under 35 cm. long, native.

Spines clear yellow.

Plants glaucous; spines straight, slender, acicular; reflexed; plants of rocky canyons in or near the deserts ..... *O. chlorotica Engelm. & Bigel.*

Plants green; spines curved, thick, subulate, not reflexed, somewhat spreading; coastal .... *O. littoralis (Engelm.) Ckrl.*

Spines not yellow.

Plants not very spiny; spines white to somewhat brownish; ovary not more than twice as long as wide, flowers a bright salmon ..... *O. Vaseyi (Coulter) Britt. & Rose*

Plants very spiny; spines brown or red-brown, at least at base, or if white, stout; flowers yellowish.

Spines twisted; red-brown at base; fruit small, about 4-7 cm. long.

Joints 20-30 cm. long, orbicular to elliptical; spines porrect to somewhat spreading, decidedly angled, reddish yellow to yellow distally; plants of eastern Mojave Desert ..... *O. phaeacantha Engelm. var. mojavensis (Engelm.) Fosberg*

Joints 10-20 cm. long, obovate to orbicular or rhombic; spines porrect or reflexed, somewhat angled basally, red-brown throughout or white distally.

Plants usually erect, bushy; spines porrect to somewhat spreading; plants of cismontane Southern California ..... *O. phaeacantha Engelm. var. Covillei (Britt. & Rose) Fosberg*

Plants very low to prostrate; spines porrect around edges of joints, usually reflexed on sides; plants of mountains bordering deserts, usually on the desert slopes ..... *O. phaeacantha Engelm. var. Piercei Fosberg*

Spines not twisted, dark brown or light brown at base or white throughout, fruit large, 7-12 cm. long.

Spines heavy, flattened, white throughout or brownish at base; plant low or prostrate; fruit mostly large; plants of canyons emptying into the deserts ..... *O. Engelmannii Salm-Dyck, var. megacarpa (Griffiths) Fosberg*

Spines slender, somewhat flattened, dark brown at base, distal third white; plant decumbent to ascending, bushy; fruit medium to large; plants of cismontane Southern California, usually in the sage-brush belt, occasionally in chaparral ..... *O. occidentalis Engelm. & Bigelow*

The foregoing key and the following descriptions, it must be borne in mind, are not at all intended to enable one to identify, to species and variety, any fleshy fruited Platyopuntia found in Southern California, but only those which in all or most superficial characters resemble *one* of the presumed ancestral forms

which enter into the makeup of this group. Those plants which show characters of more than one ancestral form may with this treatment be analyzed and their approximate ancestry determined.

Opuntia littoralis (*Engelm.*) *Cockerell,* Bull. So. Calif. Acad. 4:15, 1905.

O. Engelmannii littoralis Engelm. in Brew. & Wats. Bot. Calif. 1:248, 1876.

O. Lindheimeri littoralis Coult. Contr. U. S. Nat. Herb. 3:422, 1896.

Plants large, decumbent to ascending or erect, forming large clumps up to 1.5 m. tall; joints elliptical (in one form orbicular); epidermis bright green, old joints at the base of the plant gray-brown and so thick as to appear almost cylindrical, joints 20-35 cm. long; spines clear yellow, thick, subulate, usually curved, porrect spreading, unequal, usually less than 2.5 cm. long; ovary up to 7 cm. long, thick in upper part, narrowed below, somewhat spiny; flowers yellow, up to 10 cm. across; fruit pyriform to globose.

Along the coast of California and on the islands off the coast, from Santa Barbara County to somewhat south of Todos Santos Bay, Baja California. The form in the San Pedro Hills, Los Angeles County, is erect, very large, with orbicular joints, short spines and globose fruit. Fosberg No. 8614, collected just south of the Palos Verdes Estates, San Pedro Hills, is a rather young joint of this. Further study may reveal this to be a good variety.

Opuntia occidentalis Engelm. & Bigelow, Proc. Amer. Acad. 3:291, 1856.

O. Engelmannii occidentalis Engelm. in Brew. & Wats. Bot. Calif. 1:248, 1876.

O. Lindheimeri occidentalis Coult. Contr. U. S. Nat. Herb. 3:421, 1896.

Plants large, decumbent to ascending, forming large clumps up to 1 m. or a little more tall; joints oblong to lanceolate-oblong, 10-35 cm. long, glaucous, old joints at times becoming brownish; spines dark brown in the basal half or two-thirds, white distally, slender, acicular but somewhat thickened at base, the longest 2-3 cm. long, porrect, the two other principal ones almost as long and spreading downward, all straight; ovary narrowed and elongate at base, three or more times as long as wide at widest part, somewhat spiny; flowers yellow, up to 10 cm. across, fruit narrowly pyriform to ellipsoid with elongate base, red-purple.

Throughout the sagebrush belt of Southern California from Ventura County south, probably extending some distance into Baja California, occasional in the lower chaparral belt, frequent-

ing steep hillsides, alluvial fans and washes. A rather normal specimen of this is Fosberg No. 8613 from the chaparral belt in Laurel Canyon in the Hollywood Hills, Los Angeles County. Fosberg No. 8612 is a form with unusually small joints, long spines and weak, prostrate habit from the San Pedro Hills near Palos Verdes Estates, Los Angeles County.

Mr. George Goodman of the Missouri Botanical Garden has very kindly examined for me the type specimen of O. occidentalis, collected near Los Angeles, Calif. by J. M. Bigelow on March 19, 1854. He has sent me a sketch, a general description and copies of the label and of Engelmann's notes and drawings which accompany the type sheet. From this information I have prepared a short diagnosis of the important characters of the type specimen.

Plant about 1 m. tall, erect; joints obovate to elliptical (acute at both ends) (type joint elliptical), 30 cm. long, 20 cm. wide; 3-5 spines in an areole, mostly deflexed, the largest over 3 cm. long, flattened but not angled, white with a brown base and a yellowish tip, straight, somewhat subulate, twisted ½ to ¾ turn; fruit ellipsoid-truncate, 5 cm. long, 3 cm. wide, umbilicus broad and rather flat; seed 5-6 mm. broad, rather thick, with a crenulate-wavy callus 1-1.5 mm. high but rather thin, ⅓ the thickness of the body of the seed. The type specimen is composed of a joint with one fruit. The spines have now aged, for the most part, to a very light brown.

This description does not agree, in some particulars, with the concept of this species set forth above. The possibility presents itself that the type is a hybrid, and in fact it is scarcely likely that Bigelow would have accidentally selected one pure plant out of thousands of hybrids that must have been present. The twisted spines and erect habit suggest O. phaeacantha var. Covillei, the obovate joints suggest either the var. Covillei or O. Vaseyi, while the deflexed spines suggest the latter. Mixtures of these two with O. occidentalis are common enough in the region around Los Angeles, where the type was collected. The form of the fruit also suggests O. Vaseyi.

V Opuntia Engelmannii Salm-Dyck, var. megacarpa (Griffiths) Fosberg n. comb.

O. megacarpa Griffiths, Ann. Rept. Missouri Bot. Gard. 20:91, 1909.

Plants prostrate to somewhat ascending, up to .5 m. tall, joints large, 20-35 cm. long, thick, glaucous; spines white, sometimes with brownish base, up to 4 cm. long, strongly flattened, one longer, two or three medium length, somewhat reflexed and spreading, heavy and strong; glochids conspicuous, yellow or brown, 1 cm. long; ovary at times somewhat elongate at base,

rather narrow, sometimes slightly spiny; flowers yellow inside, somewhat bronzed on the outside, 7 cm. across; fruit cylindro-ellipsoid, purplish, up to 12 cm. long, umbilicus U shaped.

The type locality of this plant is at Banning. I have collected it at Mission Creek (8607) and at Horsethief Flats (8608), the former in Riverside County at the east base of the San Bernardino Mts. at the edge of the desert, the latter at the north base of the same range in San Bernardino County. I have observed it in San Felipe Valley, eastern San Diego County. Mr. Wright M. Pierce has a plant from this locality growing in his garden. I do not consider the seeds especially large for this group, as emphasized by Mr. Griffiths. I have found that the seeds vary greatly in size in all the species of this group, even within the same variety.

This variety, in its fruit characters seems to break down the distinction between O. Engelmannii and O. occidentalis. Vegetatively it seems much more like the former. Britton and Rose considered it identical with O. Covillei, to which it has little resemblance.

Opuntia Vaseyi (Coulter) Britt. & Rose, Smiths. Misc. Coll. 50:532, 1908.

O. mesacantha Vaseyi Coulter, Contr. U. S. Nat. Herb. 3:431, 1896.

Main stems prostrate, secondary branches erect, forming large clusters, sometimes over 5 dm. tall, joints obovate, up to 25 cm. long, light green, somewhat glaucous or purplish; spines one or two, sometimes absent, up to 2 cm. long, usually shorter, whitish, acicular to somewhat subulate, deflexed; ovary short and thick, not elongate at base, not more than twice as long as thick, up to 5 cm. long, spineless; flowers deep salmon colored, about 7 cm. across; fruit ellipsoid, 4-6 cm. long, red-purple.

Abundant in the washes, canyons, foothills and alluvial fans at the foot of the cismontane slope of the San Gabriel Mts. Less common at the foot of the San Bernardino Mts. Reported as abundant in the hills near Riverside and in Santa Ana Canyon. Present in the hills around Pomona. The confusion with regard to the type locality of this plant is discussed by Britton & Rose in detail (Cactaceae V. I, p. 146). I have seen a photograph of the type and it certainly seems to be this plant. The drawing reproduced by Britton & Rose (Cactaceae V. I, p. 146, fig. 185) does not represent the normal appearance of O. Vaseyi, but seems to be one of the peculiar elongate forms produced by plants growing in the shade. Fosberg No. 8615 collected near Claremont is a normal joint of this species in fruit.

Opuntia phaeacantha Engelm. var. Covillei (Britt. & Rose) Fosberg n. comb.

O. Covillei Britton & Rose, Smiths. Misc. Coll. 50:532, 1908.

Plants erect and bushy, solitary or sometimes forming clumps, up to 1 m. tall; joints obovate to almost orbicular, light green, sometimes slightly glaucous, old areoles appearing black, joints up to 20 cm. long; spines bright red-brown, up to 6 cm. long, principal one porrect, shorter secondary ones somewhat spreading, principal spine usually twisted near middle, somewhat angled in basal half, acicular; ovary slender, somewhat elongate at base, slightly or not at all spiny; flowers yellow, 7-8 cm. across; fruit slender, about 5 cm. long, red, umbilicus somewhat depressed.

This plant is common in the washes and alluvial fans at the base of the San Gabriel-San Bernardino Mts. and extends through most of the interior valleys in the coastal sage belt. It can be found abundantly in a more or less pure condition near San Bernardino, the type locality, and especially near San Fernando. Fosberg No. 8609 from San Fernando is a good representative joint.

Opuntia phaeacantha Engelm. var. Piercei Fosberg n. var.

Plants prostrate, in small clumps, sometimes "crawling" by growing at one end and dying back at the other; joints obovate to orbicular, or somewhat rhombic, light green to purplish, up to 20 cm. long; spines single or nearly so, up to 8 cm. long, dark red-brown to whitish, porrect on the edges of the joints, usually decidedly reflexed on the sides, acicular, usually twisted near the middle, somewhat angled in the basal half; ovary slender, decidedly narrow toward base, nearly or quite spineless; flower pale yellow, up to 6 cm. across; fruit slender, red, up to 5 cm. long, umbilicus shallowly V shaped.

Caules prostrati; articuli obovati vel orbiculati vel rhombiformi, quotcumque 20 cm. longi; spinae plerumque solae, quotcumque 8 cm. longae, castaneae subnigrae vel albae, aciculiformes, tortae; ovaria angusta, plerumque sine spinis; florae subflavae, quotcumque 6 cm. in diametro; fructi angusti pyriformi, quotcumque 5 cm. longi.

I take great pleasure in dedicating this variety to Mr. Wright M. Pierce who has had it under observation for some time and who first called my attention to it. The type specimen is Fosberg No. 8637 from Gold Mountain, San Bernardino Mts., San Bernardino County, Calif., above Baldwin Lake, altitude 2,100 m.

approximately. Cotypes are Fosberg No. 8639 from near Warner's Hot Springs, eastern San Diego County, and Fosberg No. 8610 from Camp Baldy, San Gabriel Mts. near the boundary between Los Angeles and San Bernardino counties. I have also seen a specimen in the Herbarium of the Los Angeles Museum collected by Mr. Fisher from Mint Canyon, San Gabriel Mts., that seems to be this variety. I observed material of var. Piercei on Arrastre Creek, below Cactus Flats, near slope of the San Bernardino Mts. This had very noticeably orbicular joints and very long spines. Mr. Baxter, in his article referred to above, discusses this plant as O. mojavensis from the canyons on the north slope of the San Gabriel Mts. Thus its range seems to be from just above the desert up to over 2,000 m. in the mountains bordering the deserts of Southern California. The few specimens in herbaria may usually be found under O. Covillei.

V OPUNTIA PHAEACANTHA ENGELM. VAR. MOJAVENSIS (ENGELM. & BIGEL.) FOSBERG N. COMB.

Opuntia mojavensis Engelm. & Bigelow, Proc. Amer. Acad. III: 293, 1856.

Main branches, evidently prostrate, secondary ones erect, forming small, compact, bushy clumps up to .5 m. tall; joints orbicular to elliptical, bright yellowish green, 20-30 cm. long; spines red-brown at base, yellow or yellowish-brown distally, principal one porrect, up to 6 cm. long, usually twisted near the middle, decidedly angled, sometimes somewhat curved, secondary ones spreading, shorter; ovary spineless, slender, narrow near base, flowers pale yellow, up to 6 cm. across; fruit slender, narrowed at base, (drawing shows sterile fruit of type specimen almost cylindrical—Pac. R. R. Rept. Whipple Exp. V; Pl. 22, figs. 6-8), 5 cm. long, red, umbilicus shallowly V shaped.

Type locality rather uncertain. In the treatment of this species in Engelmann's "Synopsis" (Proc. Amer. Acad. III: 293) the type locality is given as "On the Mojave, west of the Colorado." In the treatment in the report of Whipple's Expedition (V:40, 1856) published at almost the same time by the same authors it is given as "Mohave Creek." However, the plant does not seem to occur on the Mojave. In Dr. Bigelow's general discussion of the botany of the expedition (l. c. p. 14) he refers to the whole region from the tops of what are now known as the Providence Mts. to Cajon Pass as Mojave Creek. Here he mentions what seems to be this plant in the region between the Colorado and the Mojave rivers. He does not mention it in discussing the Mojave proper. After reading carefully all the remarks in this report which seem to have a bearing on the problem I am inclined to consider the Providence Mts. as the place where the type was collected.

This plant is known, evidently, from only two collections subsequent to the type collection, one by Dr. P. A. Munz from near Bonanza King Mine, Providence Mts., May 21-24, 1920, the other by Mr. Wright M. Pierce from near the Searchlight Road on the California side of the California-Nevada boundary. The latter specimen is growing in Mr. Pierce's garden in Claremont, a cutting also in the garden of Mrs. Ysabel Wright in Santa Barbara.

University of Hawaii,
Honolulu, Jan. 6, 1933.

CALIFORNIA EUPHORBIA NOTES

By Louis C. Wheeler

The Euphorbia species occurring in California need nomenclatorial corrections. A partial synonomy, without combinations in the segregate genera, is given. A new species, species new to California, and range extensions of species known to occur in the state are recorded. These notes are excerpts from an extended study of the section Anisophyllum. The synonyms given are, in most cases, based on a critical study of the type or isotype concerned.

Material has been available for study from the following herbaria: Pomona College (P); Field Museum (F); Dudley Herbarium of Stanford University (D); University of California at Los Angeles (UCLA); University of California at Berkeley (C); Los Angeles County Museum (L); Rancho Santa Ana Botanic Garden (RS); Herbarium of Frank W. Peirson (Peir); Herbarium of Louis C. Wheeler (W). The abbreviations given are those used in citing specimens.

Section Tithymalus

Euphorbia helioscopia L. This weed which is frequent in Eastern United States has been reported as far south as Elk, Mendocino Co., California by Howell, Madroño 2:20, 1931. It is well established in the truck gardening section south of El Monte, Los Angeles Co., Calif.: SE. El Monte, *Wheeler in 1933* (W, P); Portrero Chico 5 miles SW. El Monte, *Wheeler 1936,* in 1933 (W, P, UCLA, Peir).

Section Anisophyllum

Euphorbia arizonica Engelm. in Torr., Bot. Mex. Bound., 186. 1858. E. *versicolor* Greene, Bot. Gaz. 6:184. 1881. E. *puriisimana* Millsp., Proc. Cal. Acad. Sci. II 2:225. 1889. E. *portulana* Wats., Proc. Am. Acad. 24:73. 1889. E. *collina* T. S. Brandegee, Univ. Calif. Pub. Bot. 4:184. 1911.

This species is unreported from California. There have been two collections: Riverside Co.: Andreas Canyon, Palm Springs Region, *Peirson 4256* in 1922 (Peir). San Diego Co.: Palm Canyon, Borrego Valley, *Templeton 1632* in 1932 (P, L).

Euphorbia capitellata Engelm. in Torr., Bot. Mex. Bound., 188, 1859. *E. pycnanthema* Engelm. ibid. *E. chamberlinii* Johnston, Proc. Cal. Acad. Sci. IV 12:1066, 1924.

This species is abundant in southern Arizona but there is only one collection which I have seen from California which is referable to this species and there is some uncertainty as to

whether this collection is really from California: "San Jacinto Mts. Alt. 6000-8000 ft. Estelle Strasburg. Legit.: *M. F. Spencer* [in] 1923 [#] 428" (F). No state or county was given. There seems to be no such mountain range in Arizona. A personal visit to Mrs. Strasburg, who evidently was supposed to have been the actual collector, revealed that she frequented the San Jacinto Mts., Riverside Co., Calif., at about the date given. She did not recognize the plant but there is nothing striking in its appearance to impress it on the memory and she is rather advanced in age anyway. Also the date could not be checked as she had recently destroyed her diaries. The shadow of doubt concerning the source of the specimen must remain.

Euphorbia cinerascens Engelm. in Torr., Bot. Mex. Bound. 186. 1859.

This species (which I intend to reduce to a variety of another species elsewhere) was reported by Parish in MacDougal, Carn. Inst. Wash. Pub. 193:110, 1914, from Figtree John Spring, Riverside Co., Calif., *Jepson 6074* in May 1914 (J). It is hoped that it is *E. polycarpa* Benth. var. *hirtella* Boiss. *E. cinerascens* Engelm. ranges from southwestern Texas south through Coahuila to Taumalipas and San Luis Potosi.

Euphorbia eremica Jepson, Man. Fl. Pl. Calif., 600, 1925. This unique species seems to be known only from the type: Coachella Valley (Conchilla Desert), at ca. 200 ft. alt., Riverside Co., Calif., *Jepson 6074* in May 1914 (J). It is hoped that further collections will be made.

Euphorbia fendleri T. & G. Pacific Rail. Rep. 2 pt. 2:175, 1855. *Chamaesyce gooddingii* Millsp. Field Mus. Pub. Bot. 2: 406. 1916.

Only three collections of this species have been made in Calif.: "Desert Wells, Southeastern California" *Purpus* 5687 in 1897 in part (C). Judging by the fact that the other part of this number is *E. ocellata* D. & H. var. *arenicola* (Parish) Jepson it must have come from the region of the Sink of the Mohave River in eastern Mohave Desert as this variety is confined, in California, to this region. . . . Clark Mt., eastern Mohave Desert, San Bernardino Co., *Jaeger* 22 June, 1930 (P). Westgard Pass, White Mts., Inyo Co., *Duran 547*, 27 June, 1930 (P, C, D, RS). This last was reported by Howell, Leafl. West. Bot. 1:54, 1933.

Euphorbia micromera Boissier, DC. Prod. 152:44. 1862. *E. pseudoserpyllifolia* Millsp. Pittonia 2:87. 1890. *E. podagrica* Johnston, Univ. Calif. Pub. Bot. 7:440, 1922.

In the herbaria at least half of the specimens referred to this species are *Euphorbia polycarpa* with narrow appendages. About half of the *E. micromera* is referred to *E. polycarpa*. The char-

acters which distinguish *E. micromera* from the other entire-leaved species of this section in California are: Involucre short campanulate, contracted above, lobes entire; glands discoid or nearly so; appendages always wanting; sinus little depressed; staminate flowers 5-6; seeds quadrangular, smooth or with faint wrinkles.

I have seen the following collections from California: Inyo Co.: Owens Lake, *Purpus 3046* (C). Riverside Co.: San Gorgonio Pass at Cabezon, *Howell 6657* (F, CA); Cathedral City, *Howell 6651* (CA, type of *E. pseudoserpyllifolia* Millsp. forma *villosa* Howell); Figtree John Spring, *Parish 8245* (F, D); Salton Bench Mark, *Wheeler 369* (W, P, Peir); Desert Center, *Jones 24879* (UCLA, C, CA, P in part). Imperial Co.: Old beach near Holtville, *Parish 8087* (C, D); 10 miles SE. Holtville, *Munz & Hitchcock 12126* (P); Imperial, *Wales in 1904* (C); Heber, *Abrams 4097* (P); between Brawley and Salton Sea, *Parish 8301* (G, D, F "SW. Brawley" on this label); Colorado River bottoms at Fort Yuma, *Parish 8307* (D, F).

Euphorbia ocellata D. & H. var **Rattanii** (Wats.) Wheeler n. comb. *E. Rattanii* Wats., Proc. Am. Acad. 20:372. 1885. This differs from typical *E. ocellata* only in being beset throughout, except on the gynoped (pistillate pedicel) and style tips, with short stout spreading hairs, and the glands are sometimes with narrow white appendages. I have not seen the type from Colusa Co. I have seen: Newville, Glenn Co., *Heller 11555* (C, D, F, G). This variety seems to be rare and confined to the two counties named.

Euphorbia Parishii Greene, Bull. Cal. Acad. Sci. 2:56. 1887. *E. patellifera* J. T. Howell, Leafl. West. Bot. 1:53. 1933. The distinctive characters of this species were well pointed out by Greene in the original publication except that there are 40-50 staminate flowers per involucre. I have seen the following specimens:

California: Inyo Co.: Furnace Creek, Death Valley, *L. S. Rose 33421* (CA); Funeral Mts., Death Valley, *Jones in 1907* (D, P); Stove Pipe Wells, Death Valley, *Munz & Hitchcock 11032* (P); Surprise Wash, *Parish 10216* (C, F); Surprise Canyon, *Parish 10217* (C); Emigrant Springs, *Parish 10190* (C); Panamint Valley, *Parish 10191* (C, F); Greenwater Flat, *Parish 10138* (C); Emigrant Canyon, *Ferris, Scott & Bacigalupi 3998* (D). Kern Co.: Red Rock Canyon, *Knapp in 1888* (C). San Bernardino Co.: Mohave Desert: Baxter, *Parish 9883* (C); Ludlow, *Jones in 1926* (P); Daggett, *K. Brandegee in 1904* (C); Warm Springs, Parish (D) isotype of *E. Parishii* Greene). Riverside Co.: Colorado Desert: Mecca, *Parish 8113* (D); Cottonwood Springs, *Parish 10829* (D). San Diego Co.: Palm

Wash, western Colorado Desert, *Howell 3488* (F, isotype of *E. patellifera* Howell).

This species is usually included in that catch-all *E. polycarpa* in herbaria.

Euphorbia pediculifera Engelm. in Torr., Bot. Mex. Bound., 186. 1859. *E. involuta* Millsp., Proc. Calif. Acad. Sci. II 2:227. 1889. *E. conjuncta* Millsp., ibid. *E. vermiformis* Jones, Con. West. Bot. 16:23. 1930.

This is rare in California. There are only three collections: Imperial Co.: Carrizo (Cariso) Mt., *T. S. Brandegee in 1905* (C, cited by Jepson, Man. Fl. Pl. Calif., 600. 1925.): Midway Well, *Peirson 9796* (Peir, W); 20 miles NE. Ogilby, *Munz & Hitchcock 12155* (P).

Euphorbia petrina Wats., Proc. Am. Acad. 24:75. 1889. *Euphorbia polycarpa* Benth. var. *petrina* (Wats.) Johnston, Proc. Cal. Acad. Sci. IV 12:1072. 1924. This species is confined to the lower half of Lower California, southern Sonora, and Sinaloa. None of the California plants are referable to it. It is distinguished from *E. polycarpa* by having 5 rather than 12-25 staminate flowers per involucre, and by the more reduced bracteoles.

Euphorbia Preslii Guss.

This seems not to have been reported from Southern California. I have seen one collection: Santa Ana, Orange Co.: *Helen D. Geiss in Apr. 1902* (D, P). As it has not reappeared it has evidently not become established.

Euphorbia serpens H. B. K.

The report of this species from California by Parish in MacDougal, Carn. Inst. Wash. Pub. 193:110. 1914, was based on a misdetermination by Millspaugh. I have examined the specimen on which the report was based: Durmid, Imperial Co., *Parish 8066* (D); and it is *E. albomarginata* T. & G. I have seen also another specimen of *E. albomarginata* determined by Millspaugh as *E. serpens*: Grand Canyon of the Colorado, Coconino Co., Arizona, *Millspaugh* 149 (F). It appears that he was unable to distinguish between *E. albomarginata* in forms with narrow appendages, and *E. serpens*. The two are readily distinguishable by the fact that the former has 12-25 staminate flowers while the latter has only 5-6 staminate flowers per involucre. There are also other differences most of which are not absolute.

Euphorbia setiloba Engelm. in Torr., Pacific Rail. Rep. 5:364. 1857. *E. floccosiuscula* Jones, Con. West. Bot. 15:145. 1929.

This is unreported from Mohave Desert.

Specimens: Co.? "on Mohave Desert," *Curran in 1884* (D). Inyo Co.: Shepherds Canyon, Argus Mts., *Jones in 1897* (P, D, F). San Bernardino Co.: 3 miles N. Cave Spring, Mohave Desert, *Peirson 8705* (Peir).

✓ **Euphorbia Abramsiana** Wheeler, new species.

Chamaesyce saltonensis Millsp., in Carnegie Inst. Wash. pub. 193:110. 1913, as *nomen nudum.*

Section *Anisophyllum.* Subsection *Chamaesyce.*

Planta prostrata, annua; caulibus tenuibus, puberulentis; foliis oppositis, subglabratis; laminis 2-7 mm. longis, oblongis aut elliptico-oblongis, inaequilateralibus, cum apice obtuso, margine integro aut pauce serrato in foliis majoribus; petiolis brevibus; stipulis ca. 0.5 mm. longis, distinctis, in 2-multa loba partitis, parce pubescentibus; pedunculis brevibus; involucris in axilis solitariis sed in ramis brevibus lateralibusque congestis, turbinatis, 0.6-0.7 mm. latis; lobis proximis glandulas superantibus, in 3-4 segmenta tenua et glabra partitis; glandula quinta glandulas aequante; sinu angustissimo; glandulis transverso-oblongis, 0.05-0.1 mm. longis; appendiculis glandulas fere latioribus, integris aut bilobatis; bracteolis appendiculum filiforme et 0.2-0.3 mm. longum ferentibus, involucrum infra adnatis; andropedibus 3-5 in involucro, 0.5 mm. longis; gynopedibus exsertis sed non reflexis; stylis bifidis, glabris, clavatis, 0.3 mm. longis; capsulis glabris, globosis ca. 1.3 mm. longis, acute 3-angulatis; seminibus ca. 1.2 mm. longis, acute quadrangularibus, radiale oblongo-ovatis, base truncatis, cum 5-6 rugis irregularibus transversisque, albis.

Prostrate annual; stems to 20 cm. long, finely pubescent, slender (mostly not over 1 mm. diam.), internodes to 1.5 cm. long below, gradually shortening upward; leaves opposite, shortly puberulent to glabrous, blades 2-7 mm. long, oblong to elliptic-oblong, inaequilateral, apex obtuse, margin often strongly revolute at least on drying, with a few teeth on some of the larger leaves at the apex and the long side of the base, petioles ca. 1 mm. long; stipules distinct, less than 0.5 mm. long, the upper usually 2-3 parted, the lower several parted, with a few hairs; peduncles to 1 mm. long, glabrous; involucres ca. 0.6-0.7 mm. diam., solitary in the axils but mostly congested in groups of 5 to 10 on very short leafy lateral branches, glabrous within and without, turbinate, tapering to the peduncle; proximal lobes (those next to the sinus) greatly exceeding the glands, each deeply parted into 3 or 4 slender glabrous divisions, the other lobes exceeding the glands, mostly parted into 2 slender glabrous segments, all the lobes with a few hairs within at the base; 5th

gland equaling the glands, filiform, glabrous, sinus almost wanting, not depressed making the 5th gland appear somewhat as one of the divisions of the lobes; glands transversely oblong, pinkish to ochroleucous, 0.05-0.1 mm. long; appendages mostly wider than the glands, white, glabrous, entire or slightly two-lobed; bracteoles reduced to one appendage opposite each gland, adnate to the involucre below, free portion 0.2-0.3 mm. long, slenderly filiform, of one or two segments, with a few short hairs; andropeds (staminate pedicels) 3 to 5 per involucre, glabrous, ca. 0.5 mm. long; gynoped (pistillate pedicel) glabrous, exserted but not reflexed; ovary glabrous, styles bifid, glabrous, clavate, ca. 0.3 mm. long, rotately spreading but the tips slightly ascending; capsule glabrous, spheroid, ca. 1.3 mm. long, sharply 3-angled; seeds sharply quadrangular, ca. 1.2 mm. long, ca. 0.5 mm. radially and tangentially, oblong-ovate radially, base truncate, front facets slightly concave, back facets plane, all with 5 to 6 irregular transverse wrinkles slightly including the angles, coat white, microreticulate.

Distinguished from *E. prostrata* Ait. primarily by the very long (in relation to the glands) and much parted involucral lobes, the very narrow sinus, and the minute glands. Distinguished by the narrow sinus from *E. maculata* in which the sinus is U-shaped and considerably depressed, the wrinkled seeds and the greatly reduced bracteoles.

Type Loc.: Heber, Imperial (San Diego) Co., California.

Dist.: Southeast Colorado Desert, California, southern Arizona, and northern Sonora.

Specimens examined: California: Imperial Co.: Heber, *Abrams 4097* (D, type, sheet No. 33555); Streets of Brawley, *Parish 8305* (G); Old beach east of Calexico, *Parish 8302* (G); near Calexico, *Abrams 3995* (D); 4 miles N. Calexico, *Abrams in 1902* (D). Arizona: Co.? Wilmot, *Thornber 341,* in part (D). Sonora: Carbo, *Jones 22606* (P).

Some of the sheets distributed under *Abrams 4097* are *E. micromera* Boissier.

Key to the Principal Serrate-leaved Annual Species of California

Stamens ca. 5

A. Proximal lobes greatly exceeding the glands and parted into 3-4 linear segments ..... *E. Abramsiana*

B. Proximal lobes not greatly exceeding the glands and mostly entire.

1. Plant usually more or less hairy; sinus depressed one-third of way to base of involucre, hairy; seeds smooth or slightly wrinkled ..... *E. maculata*

2. Plant glabrous; sinus not depressed, glabrous.

a. Seeds with transverse wrinkles including the angles ..... *E. glyptosperma*

b. Seeds smooth or slightly wrinkled ..*E. serpyllifolia*

Stamens ca. 10

A. Plant glabrous; sinus not depressed, glabrous ..... *E. serpyllifolia*

B. Plant usually more or less hairy; sinus slightly depressed, hairy ..... *E. hirtula*

It appears that what commonly passes for *E. serpyllifolia* may be separable into distinct entities on the basis of stamen numbers primarily. *E. occidentalis* Drew appears to be closely related to *E. hirtula*.

LaVerne, Calif.

PROCEEDINGS OF THE ACADEMY

October, 1933 - September, 1934

Regular Meetings

The regular meetings of the Academy are held the second Saturday evening of each month at 7:30 p. m., in the Lecture Room of the Los Angeles Library.

October 14, 1933:

The first meeting of the fall was held in the Lecture Room of the Public Library.

President-elect Harry K. Sargent gave a most interesting lecture on "Measuring the Universe." The audience, which taxed the capacity of the room, listened intently to the "story of the heavens," explained by Mr. Sargent in a way that could be understood by the average layman. The illustrations thrown on the screen were well chosen and pictured the many wonderful things in the sky which can be seen through a telescope.

November 11, 1933:

The "Personality of Birds" was the subject of Mr. Frederic S. Webster's lecture on the evening of November 11, at the regular meeting of the Academy. Mr. Webster, formerly of the staff of the Carnegie Museum, Pittsburg, told of his experiences with birds of the Atlantic Coast and pointed out their human traits. The lecture was illustrated with colored views made by the speaker. The meeting was attended by a large and enthusiastic audience. Many of those present expressed their desire to have Mr. Webster speak again before the Academy.

December 9, 1933:

The deserts of the Southwest, especially the Mojave and Death Valley, were vividly pictured by W. Scott Lewis on the evening of December 9. His subject—"Land of the Great Silence"—was treated in a most interesting way and his beautiful colored slides were greatly enjoyed by an audience which filled the lecture room. The views showing mirages on the desert were especially fine.

January 13, 1934:

The story of the early inhabitants of Chaco Canyon, New Mexico, was shown on the screen by Dr. Edgar L. Hewett, Professor of Archeology of the University of Southern California, at the first meeting of the new year. Dr. Hewett described the construction of many primitive dwellings uncovered by recent excavations in the region and told of the work of the School of American Research, Santa Fe, N. M., of which he is Director. The large audience enjoyed hearing from one who is regarded as an outstanding authority on the Indian life of the Southwest. The title of the lecture was "Excavations in Chaco Canyon, N. M. by the School of American Research, Santa Fe, N. M."

February 10, 1934:

The flora of the high Sierras was described at the February meeting by Dr. Frank J. Smiley, Professor of Botany at Occidental College. In his lecture, "Alpine Gardens of the High Sierras," Dr. Smiley gave a most interesting account of his field observations of Alpine trees, plants and flowers. The lecture was illustrated with a series of beautiful slides made from photos taken by the speaker.

March 10, 1934:

The lecture room of the Los Angeles Library was not large enough to accommodate all who wished to hear Dr. William F. Bade speak on "Digging Through the Centuries in Palestine." Dr. Bade, Director of the Palestine Institute, Pacific School of Religion, Berkeley, California, told of his archeological discov-

eries at the ancient site of Mizpah in Palestine. The lecture was illustrated with excellent colored slides, made by native artists. Members and guests expressed the opinion that the meeting was one of the most interesting they had attended in a long time.

Preceding the lecture, the Board of Directors and the Advisory Board honored Dr. Bade with an informal dinner at the Clark Hotel.

April 14, 1934:

"African Big Game" was the subject of Mr. Joseph P. Howe of Pasadena at the regular meeting, on the evening of April 14. The large audience was treated to five most interesting reels of big game hunting in East Africa, taken by Mr. Howe on a recent hunting expedition. The pictures showed the many different species of large African mammals in their native habitat and also gave an insight into the everyday life of the African natives.

May 12, 1934:

The lecture at this meeting, the last one before the summer vacation, was delivered by Dr. W. H. Burt of the Museum of Vertebrate Zoology, California Institute of Technology, Pasadena. The subject was "Radiate Adaptation in Mammals." Dr. Burt discussed the main groups of mammals and their geographical distribution, illustrating his remarks with well-chosen lantern slides.

Board Meeting

The Board of Directors met on January 17, at the call of President Sargent. Business was transacted relative to investments of the Academy and the authorization of expenditures.

Annual Meeting

The Annual Meeting of the Academy was held on Monday evening, May 7, at the Clark Hotel. After dinner, there was a short business session at which time the President, Mr. Sargent, Dr. Bryan and Mr. Spaulding made brief talks dealing with the work of the organization. The Secretary gave his report and the President announced the re-election of the Board of Directors.

Later in the evening, the members listened to a most interesting lecture by Mr. B. R. Baumgardt on "Spain and the Alhambra," which dealt with the contribution of the Moors to civilization. The lecture was illustrated with beautiful lantern slides.

Howard R. Hill, *Secretary*

BULLETIN of the SOUTHERN CALIFORNIA ACADEMY of SCIENCES

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Publications of the
Southern California Academy of Sciences

The Academy has published to date the following:

PROCEEDINGS. 1896 to 1899. Six numbers—Vol. 1, Nos. 1 to 6.
MISCELLANEOUS BULLETINS issued under the imprint of the Agricultural Experiment Station—1897 to 1907. Ten numbers.

All issues of the above are now out of print.

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Bulletin of the
Southern California Academy of Sciences

Began issue with Vol. I, No. 1, January, 1902. Issued ten numbers in 1902, nine numbers in 1903, 1904, 1905; three numbers in 1906. Issued two numbers annually from 1907 to 1919, both inclusive (except 1908—one issue only). Issued four numbers (January, May, July and October) in 1920.

The 1921 issues are: Vol. XX, No. 1, April; Vol. XX, No. 2, August; Vol. XX, No. 3, December.

The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

The 1923 issues are: Vol. XXII, No. 1, March; No. 2, July.

The 1924 issues are: Vol. XXIII, No. 1, January-February; No. 2, March-April; No. 3, May-June; No. 4, July-August; No. 5, September-October; No. 6, November-December.

From 1925 to 1933, including volumes XXIV to XXXII, three numbers were published each year. These were issued as No. 1, January-April; No. 2, May-August; No. 3, September-December, for each volume.

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THE OCCURRENCE OF LINGUATULIDS IN PYTHONS

By Howard R. Hill
Zoologist, Los Angeles Museum

Among the internal parasites of vertebrates, there is probably no group more interesting than the Linguatulidae, a family of degenerate arachnids closely related to the ticks and mites. Because of their rarity, they are seldom seen in zoological collections and although more than fifty species have been described, the life history of only a few is completely known. These parasites are of some pathological importance for their accidental presence in man sometimes gives rise to serious disorders.

Linguatulids are wormlike in form with cylindrical, elongate bodies which are bluntly rounded at either end. They present a ringed or annulated appearance due to circular raised folds or pleats which are present around the body from the head region to the posterior extremity. The mouth is situated on the ventral side of the head between two pairs of hooks which are used for attachment to the tissues of the host. These four hooks are the most characteristic feature of their external anatomy.

The members of this family reach their greatest development in reptiles where they occur chiefly in or near the lungs, and there become mature. Their life history normally requires two hosts, a primary reptilian host and a secondary or intermediate host, usually a mammal or fish, which harbors the larval stage. Reptiles become parasitized whenever they prey upon a mammal or fish infected with the young or larval stage.

The pythons of Africa and Asia are the hosts of two species which have a moniliform or beaded appearance and a comparatively small number of body rings. The mature form of Armillifer armillatus occurs in the African pythons, Python sebae, the rock python and P. regius, the royal python. The larval stage of this linguatulid is found in numerous small mammals such as the hedgehog, mongoose, monkey, ground squirrel and pouched rat. An additional number of larger mammals, generally herbivores, and man, sometimes serve as accidental secondary hosts. Whenever this happens, the parasitic life cycle is never completed and the nymphal forms sooner or later perish and disintegrate within their host.

The adult form of Armillifer moniliformis is found in the Oriental pythons, Python molurus, the Indian python and P. reticulatus, the netted python, while the nymphs of this species

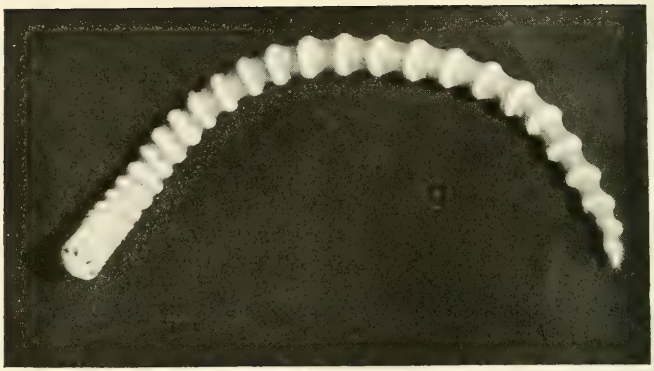

PLATE 36

Armillifer moniliformis. Female. x 1.3. Ventral view.

have been reported from the Indian otter, civet cat, lemur, Malaccan flat-headed cat, Indian leopard, tiger and man. Three cases of human infection have been noted in three widely separated regions, China, Sumatra and the Philippines.

Through the courtesy of Dr. Chas. A. Kofoid of the University of California; Dr. Marcos Tubangui of the Philippine Bureau of Science; Dr. Herbert Johnstone of the Hooper Medical Foundation, and Dr. Chas. V. Noback of the New York Zoological Society, the writer has had the opportunity of examining forty specimens of Armillifer moniliformis from the lungs of Oriental pythons. A comparative study of the material has resulted in the observation of certain facts pertaining to the external structure of the species, which have not hitherto been recorded.

The number of abdominal annulations shows slight variation and agrees, for the most part, with the figures given by Hett, Sambon and v. Heymons. Nine of the fifteen males had twenty-nine body rings (including the posterior terminal cone). One specimen had thirty-four rings which exceeds by two the greatest number of rings previously reported in any male. Nine of the twenty-five females had thirty-one rings which appeared to be the average number for the sex.

The variety name "heymonsi" proposed by Sambon for linguatulids from the netted python was based on the assumption that they were smaller, had more rings and a longer terminal segment than the typical form. The material at hand included eight female specimens from the Indian python which did not differ in number of rings from individuals of the same sex from the netted

python. In some instances, there was a relative difference in the length of the terminal-cone while in others there was not. These observations are at variance with the conclusions of Sambon and would indicate that a further comparative study of additional material is necessary before the variety "heymonsi" be accepted.

The fully grown male Armillifer moniliformis is from one-fourth to one-third the size of the mature female. Because of its small size and rarity, the male has never been thoroughly described.

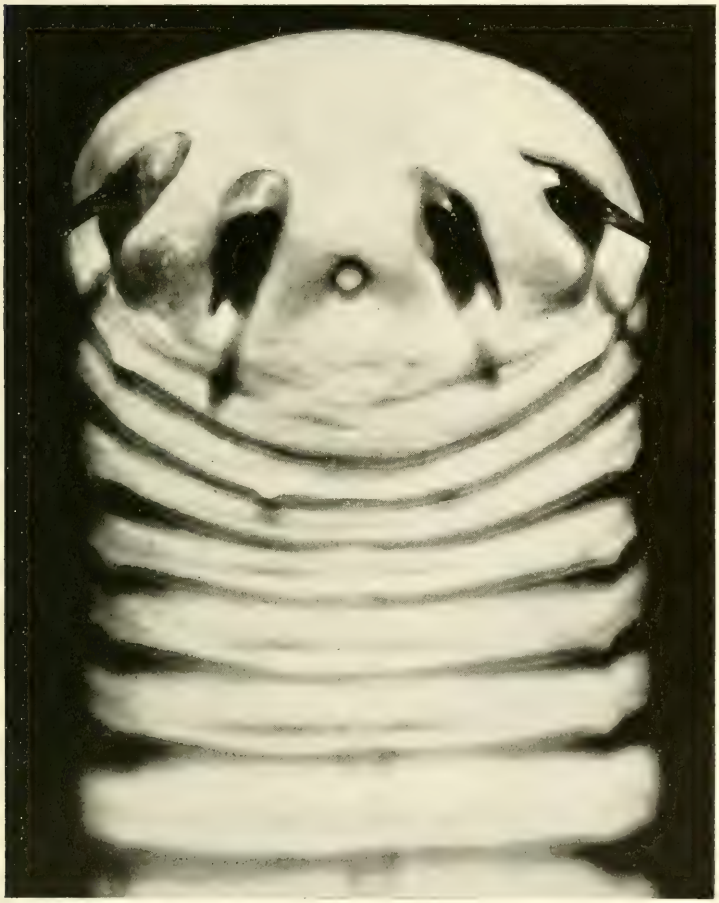

PLATE 37

Armillifer moniliformis. Female, x 21.5. Ventral view of anterior region showing hooks, circular mouth, ventro-lateral swellings; first pair of ventral secondary papillae on first annulation, below outer hooks; second pair of ventral papillae on second annulation, below inner hooks.

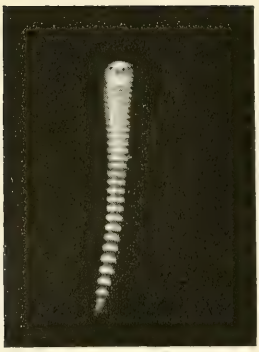

PLATE 38

Armillifer moniliformis. Male, x. 1.3.

Although it is similar in general appearance to the female, it presents a form of sexual dimorphism which has escaped the eyes of most observers. Each abdominal ring or segment in the anterior region of the body is provided on the ventro-lateral border with a pair of digitate processes, one on either side, which are directed ventrally and slightly backwards. In addition, there are four other pairs on the cephalothorax. Each process consists of a delicate, triangular outgrowth of the cuticle and terminates in a round, sucker-like disk. These structures probably function as claspers and aid the parasite in its movements or help it to adhere to the surface of some organ within the body cavity of the host. Both Sambon and v. Heymons noted these peculiar processes but regarded them as sharply-pointed denticles while Miss Hett observed their finger-like shape but did not mention the sucker pads at their distal ends.

The first and second pair of digitate processes are situated just above the outer hooks along the anterior border of the cephalothorax. The third and fourth pair project at equal distances on the ventro-lateral edge, at either side of the head and in line with the two rows which represent the abdominal pairs. The latter are more greatly developed forward and decrease in size posteriorly until they gradually disappear beyond the sixteenth segment.

In female specimens, the first five or six anterior segments are sometimes slightly swollen at the posterior edge of the segments at either side of the ventro-lateral border. The swellings are not as prominent as papillae and may perhaps represent the vestiges of the male digitate processes as they occupy the same relative position.

The position of the female genital opening on a mid-ventral swelling of the posterior terminal cone or tail segment varied somewhat in different individuals. Its usual position was about two-thirds the distance from the tip of the cone to the beginning of the next segment. It was observed however that the new body rings were formed by a division of the terminal cone so that in individuals which had just added a new segment, the genital opening was situated close to the juncture of the terminal cone and the newly formed segment.

The first annulation or segment anterior to the terminal cone differed from the other bead-like segments of the posterior half of

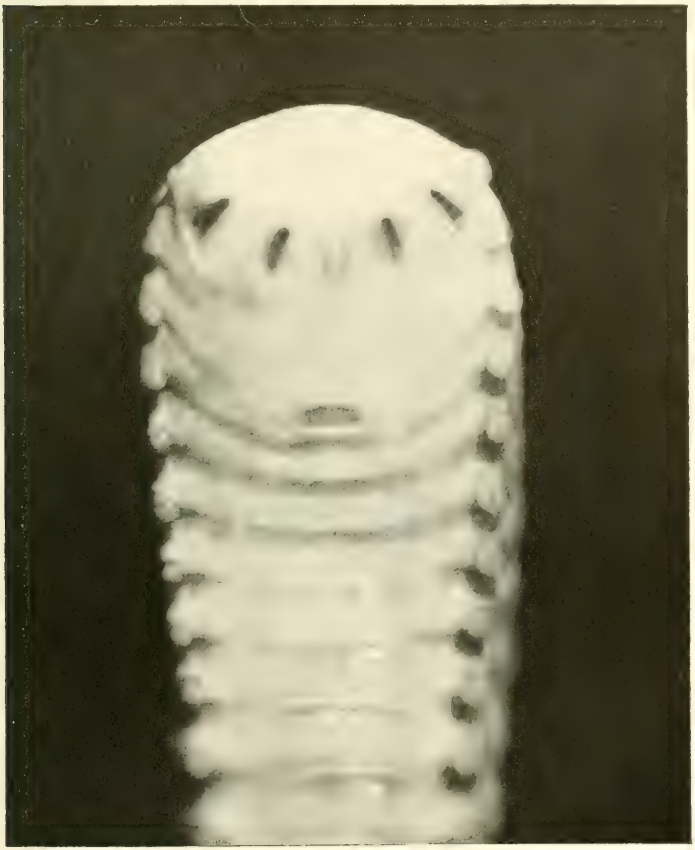

PLATE 39

Armillifer moniliformis. Male, x 21.5. Ventral view of anterior region showing hooks, mouth between inner hooks, mid-ventral genital opening on first annulation and the two lateral rows of digitate processes.

the abdomen in being flat on the ventral side. Occasionally, the same condition was also found in the second ring anterior to the terminal cone.

Slight differences in the size and shape of other external features were observed but these could be explained by differences in age and the condition of preservation of various individuals. The writer is continuing the study of this and other linguatulid species and would appreciate additional material or any information bearing on the life history of this little-known group.

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A REVISION OF THE GENUS PLEOCOMA[1]

By A. C. Davis

U. S. Dept. of Agriculture, Bureau of Entomology and Plant Quarantine

The genus *Pleocoma* is one of the most interesting and at the same time one of the most imperfectly known genera of the Scarabaeidae. Most of the papers in which it is discussed have been long out of print, and are so rare that it is very difficult or impossible to obtain them in the original. The purpose of this present paper is to bring together and summarize what is known of the life history and habits of *Pleocoma,* to discuss its systematic position in the Scarabaeidae, and to revise the genus.[2]

The genus *Pleocoma* was first described by Le Conte (*11*)[3] in 1856, the type species being *P. fimbriata* Lec. The description was drawn from a badly damaged specimen "found in California by Dr. A. H. Heerman" and is as follows:

"Clypeus (labrum?) prolongatus, antice angustatus acute rotundatus, pone apicem cornu transverso erecto furcato armatus; caput ante oculos acute extrorsum angulatum, vertice inter oculos cornu brevi erecto armatum; oculi magni vix emarginati. Antennae, 11-articulatae, articulo 2ndo sequentibus crassiore; 3io paulo elongato, 4 et 5to aequalibus, 6to paulo dilatato; 7mo adhuc duplo latiore, 8-11 lamellatis, valde elongatis aequalibus. Mandibulae, maxillaeque haud visae, palpi tenues. Thorax latus antrorsum angustatus parum convexus, disco antice declive subdeplanto. Elytra parum convexa postice late rotundata. Prosternum haud prominulum. Tibiae anticae elongatae 7-dentatae, dentibus supernis tribus minutis, 4- mediocre, 5-7 magnis; posteriores elongatae parum incrassatae, extrorsum ultra medium emarginatae et ad medium unidentatae, ad apicem oblique truncatae, ciliatae, angulo externo parum producto; tarsi (intermedii) tenues, tibia longiores, articulis 1-4 aequalibus, 5to praecedente duplo longiore, unguibus simplicibus, paranychia angusta bisetosa. Corpus subtus, os pedes elytraque ad marginem longe fulvopilosa."

During the following twenty-five years or so more specimens of the genus were taken and a better idea of its morphology was gained. Horn had a number of specimens at his disposal, and

[1] Order Coleoptera, family Scarabaeidae.

[2] The writer is indebted to H. C. Fall of Tyngsboro, Mass., for criticism and assistance, and to E. P. Van Duzee of the California Academy of Sciences; P. J. Darlington, Jr., of the Museum of Comparative Zoology, Cambridge, Mass.; E. A. Chapin of the Division of Identification and Classification of Insects, U. S. Department of Agriculture, Bureau of Entomology; L. J. Muchmore of the Los Angeles Museum, and E. T. Cresson, Jr., of the Academy of Natural Sciences of Philadelphia, for facilities extended in the examination of the specimens of *Pleocoma* in their respective institutions.

[3] Italic numbers in parentheses refer to Literature Cited at the end of this paper.

material for dissection as well. In his review of the genus, published in 1888 (*9*), he characterized it as follows:

"Form broadly oval and convex, dorsum slightly depressed, body beneath and legs clothed with moderately long reddish-yellow hair, in one species black, upper surface without hair, the margins fimbriate. Under wings well developed.

"Head relatively small, rather deeply inserted, eyes large, globular, and prominent; vertex with a short erect horn obtuse or slightly emarginate at tip; genae prolonged each side partly dividing the eye and forming a more or less acute free angle.

"Clypeus reflexed, forming a rather broad horn more or less emarginate and broader at apex.

"Antennae eleven-jointed, the first joint stout and conical, second globular but as thick; club long in the male, composed of a variable number of lamellae from four to seven, the first lamellar joint always glabrous, the others opaque, with a sensitive surface.

"Labrum broadly oval, placed either perpendicularly to the axis of the body or slightly obliquely, connate with the clypeus, but with the suture well marked.

"Mandibles visible only by dissection, placed close together against the roof of the mouth, doubtless immovable, when viewed laterally, of triangular form, the base resting against the roof of the mouth, the perpendicular against the inner side of the cypeus, outer side ciliate with long hairs.

"Maxillae small, the inner lobe in the form of a plate surrounding the outer lobe, the latter a little longer, terminated by an obtusely conical process; surface ciliate within by moderately long hairs.

"Maxillary palpi relatively long; first joint short; second longest; third half as long, conical; fourth fusiform, nearly as long as the first.

"Mentum oval, longer than wide, apex arcuate, base emarginate, supported by a broad peduncle of the submentum, the free face roughly punctured, with long hairs.

"Ligula free, arising from behind the apex of the mentum, corneous, form short and transverse, slightly emarginate.

"Labial palpi as long or even longer than the mentum and ligula, arising from the apex of the ligula, three-jointed, the last joint as long as the two preceding and more slender.

"Prothorax transverse, the sides broadly arcuate.

"Scutellum transversely oval.

"Elytra longer than wide conjointly, the apices obtuse; disc with a sutural costa, three oblique discal costae, limited usually faintly, by geminate striae, a feeble submarginal costa.

"Anterior coxae large, conical and prominent, with a large trochantin.

"Middle coxae large, very narrowly separated.

"Posterior coxae transverse as usual, rather short, contiguous at middle, but not prominent.

"Metasternal episterna narrow, the epimeron distinct.

"Abdomen with six segments, all freely movable, the first concealed by the coxae and broadly membranous at middle, segments nearly equal in length. By dissection an anal segment is observed, which is always closely retracted. Dorsal portion of abdomen consists of eight semi-membranous segments.

"Abdominal spiracles, seven on each side, are situated in the connecting membrane which unites the dorsal and ventral plates.

"Anterior tibiae with three large teeth occupying the apical half of the outer edge; four or five smaller teeth above.

"Middle tibiae broader at apex, the apical margin undulated or subdigitate, a strong transverse carina at middle of outer edge.

"Posterior tibiae similar in form, the apex, however, less undulated.

"Tarsi slender, as long as the tibiae, the first four joints slightly decreasing in length, last joint as long as the three preceding. Onychium distinct, trisetose at apex.

"Claws slender, and moderately long.

"Tibial spurs moderately long, middle and posterior tibiae each with two."

It may be added that there is a tendency for the frons to be hairy, that the posterior margin of the pronotum is sinuate, and that the midline of the pronotum is impressed, the impression being interrupted at about the posterior two-fifths.

Examination of more specimens of a greater number of species than were available to Horn shows that the second joint of the antenna is rarely if ever as thick as the first; the teeth of the anterior tibiae are variable in size and number, some specimens having them well developed and others having little or no trace of them; the tarsi are subequal to or slightly shorter than the tibiae (subequal if the tibiae are measured from the top of the tibio-femoral joint to the apex of the terminal tooth) in most cases, distinctly shorter in others; and there are eight abdominal spiracles.

The above description applies to the male, but such is the sexual dimorphism in this genus that it by no means applies as well to the female. The female is larger, more robust and convex, the under wings small and useless. Regardless of the color of the male, all the females that I have seen are some shade of brown, and the hairs of the body are shorter and lighter in color

than those of the male. The head is smaller in proportion, the clypeus less reflexed and not or very slightly emarginate. The eyes are flattened, not prominent, and sometimes hardly visible from above. The horn on the vertex is short and stout, the ocular canthi (genae) more rounded and heavier than those of the male, the antennae shorter, stouter, and the club small by comparison. The mouthparts are about the same as those of the male but all stouter and more massive. The pronotum is more coarsely and densely sculptured, and the legs more robust, shorter in proportion, the tarsi about one-third as long as the tibiae. The abdomen is convex below and very heavy. .

The mouthparts of both sexes are aborted. Being unable to eat, the males probably live for only a few days, but the females have such large masses of fat stored in their bodies that they are able to live for quite a long time. I have kept them alive for more than three weeks, at the end of which time they were apparently as lively and healthy as ever. Owing to their large fat content female specimens become very greasy when pinned in boxes.

Systematic Position

Le Conte's first specimen of *Pleocoma* was sufficiently whole to make a recognizable description possible, but it was too badly damaged to show definitely its systematic position, and as the specimen was unique, no dissection was attempted at that time. Le Conte was in doubt whether to place *Pleocoma* in the Dynastini or the Geotrupini, but he rather leaned toward the latter group, a leaning that became more pronounced as more material came to hand. Motschulsky, who had seen five specimens in the museum at St. Petersburg, and with whom Le Conte corresponded, regarded the genus as allied to *Ceratophyus* Fisher, a division of *Geotrupes*. Schaufuss (*23*, p. 59) concurred in this opinion, but noted a similarity to *Antichira* Esch. Gerstaeker (*7* and *26*) took issue with Le Conte on this question, publishing an article in which he criticised Le Conte's placing of the genus, and stated that, since *Pleocoma* was pleurostict (having the spiracles of the abdomen on the dorsal portions of the ventral segments) he would place it near the Melolonthidae, or at least in a group remote from the Geotrupini. Le Conte was ably defended by Horn, who, in two papers (*8, 9*) published the results of his investigations, which confirmed the position of *Pleocoma* as given by Le Conte, near the Geotrupini, *Pleocoma* being laparostict (having the spiracles situated upon the membrane connecting the dorsal and ventral sclerites). He also stated that he was convinced that the larva described by Osten-Sacken (*16*) was truly that of *Pleocoma*, a fact which Gerstaeker had called into question. The position of the genus in the Scarabaeidae has been the subject of some dispute since that time, and it cannot be said to be settled, although the consensus of opinion at this time seems to be that

it should follow the Geotrupini, and it has been so placed by Leng (*15*, p. 252).

Since the description of *Acoma* Casey the issue has been further clouded by the inclusion of this genus in the Pleocominae. I cannot find any authority for thus placing it, and judge that it was done from an investigation of the mouthparts alone. I have seen slides prepared by E. A. Chapin of the Bureau of Entomology which clearly demonstrate that *Acoma* is pleurostict, while *Pleocoma* is possibly the most laparostict of the laparostictines, even the eighth spiracle being functional and situated upon the intertergal membrane. Wherever the Pleocominae may eventually be placed, *Acoma* will undoubtedly have to be restored to its position near *Podolasia*, where it was placed by Casey (*1*) in his diagnosis of the genus.

Life History and Habits

The habits of *Pleocoma* have been discussed by Rivers (*19, 21, 22*), Ricksecker (*17, 18*), and others, for the most part in short papers published years ago, in which some of the information is erroneous, as, for example, the statement by Le Conte and Horn (*14*, p. 244), quoting data in a letter from Schaufuss-Blüthner, that the beetles are "frequently washed out of the burrows of the common Spermophile of California, by the heavy rains of the latter part of winter." The life history is imperfectly known.

The larva of *Pleocoma* was described by Osten-Sacken (*16*) in 1874. The larval stage certainly occupies two, possibly three or more, years. In 1915 I took a very small larva, not more than three-fourths inch long, which I believe is that of *Pleocoma badia* Fall. This larva must have been hatched from eggs laid by the brood of 1914, as adults were out and flying when it was taken and the eggs of 1915 were not yet laid. In the same year H. C. Fall, now of Tyngsboro, Mass., took a fully grown larva. I had the privilege of examining this specimen, which agrees closely with the description given by Osten-Sacken. That this larva is truly that of *Pleocoma* is certain, since the characters of the head capsule agree with those of cast-off larval skins found in holes from which adult *Pleocoma* was taken. The small larva agreed fairly well with the description in most respects. If this small larva is really that of *Pleocoma*, and had reached a length of only three-fourths inch in one year, it would probably have required two years more to have reached the size of Fall's specimen. The latter, in turn, was fully grown, but probably could not have pupated in time to emerge in that year, as adults were emerging at the time it was collected. This indicates that the life cycle may occupy as many as four years.

The larval food is not known, but I have taken no specimens of *P. behrensii* Lec. except in the vicinity of a shrub the name of

which I do not know, and I have never taken *P. australis* Fall and *P. badia* Fall far from canyon live oak (*Quercus chrysolepis* Liebm.), which leads me to believe that these species feed upon the roots of living plants. Ricksecker (*17*) notes the predominance of manzanita (*Arctostaphylos* sp.) where *P. fimbriata* Lec. was found.

Upon reaching its full size the larva approaches the surface of the ground, constructs a cell from three or four inches to a foot or more beneath it, and pupates. The pupa of *Pleocoma* has never been described. The only pupa in good condition that I have ever seen was that of a female *P. behrensii* Lec. which had been taken at a depth of about eight inches in the middle of a trail in Strawberry Canyon, Berkeley, Calif. This pupa was dug out while adults were emerging from burrows within a few inches of it. It shows little color, and the beetle probably would not have emerged until the following fall. A number of pupae that had been attacked and killed by fungi were found, indicating that the pupa lies for some time in the cell. Probably the pupal stage normally terminates late in the fall and the beetles remain quiet in their holes until the first heavy rain. All the specimens I have ever collected, including some that were dug up before they had opened their tunnels to the surface, have been fully colored and hardened.

After the first soaking rain of the wet season the greater part of the brood emerges within a few hours, the males coming out of their holes and flying about and the females opening their burrows to the surface. The males may fly every evening for several days, digging into the ground or hiding beneath rubbish in the daytime. I believe that the beetle in the pupal cell does not become active until the moisture from the rain actually reaches it. I have seen no holes from which adults had emerged, or which still contained adults, that were not damp, some of them even being filled with thin mud. This partly accounts for "holdovers," and a consequent brood every year, of a beetle that has a three-year or four-year life cycle, as some individuals construct their holes in overhanging banks where a moderate rain will not reach them, and of these a certain percentage may survive to emerge the following year if the rains are heavy. That *Pleocoma* can so "hold over" for some time is indicated by the experience of Rivers (*21*), who notes that a female specimen (*P. behrensii*, probably) was dug out of an adobe bank on February 19, 1890, four months after the second period of heavy rain on October 20 to 22, 1889, when the adults were emerging normally. It is possible that this individual might have survived six months longer, emerging the following October, as she certainly was too late to have emerged in the rainy season of 1889-90.

Nearly all of the *Pleocoma* burrows that I have seen, 600 to 800 at a guess, have been smooth and round, of about the diameter of the adult beetle, and have had very hard walls. At

the lower end each terminates abruptly in a slightly larger cavity, the pupal chamber. In burrows from which the adult has emerged there is usually very little loose dirt and the walls show no signs of recent digging. The larva apparently digs the pupal chamber and tunnel, packing and smoothing it, leaving only about an inch of the outer end to be excavated by the emerging adult. If the adult had to tunnel all the way out, the burrow would be filled with dirt. The digging ability of both adults and larvae is exceptional. I have seen holes from which adults had emerged in banks of decomposed granite so hard that digging in it with a sharp trowel was difficult. Several times I have seen females that had fallen from their burrows in steep banks, digging straight down into frozen ground that had been packed hard by automobile traffic before freezing.

Upon emerging, the males leave the burrows. Rivers (*19*) notes that they may fly on sunny days, but I believe that they normally fly only in the evening or on very dark, cloudy days, whether it is raining or not. I have had the good fortune to witness flights of *P. behrensii* and *P. badia,* and the two differ greatly in their behavior. The flight of *P. behrensii* males is direct and very swift, and if one misses the first sweep at them with the net they are off at once so swiftly that they soon disappear over the tree tops. The males of *P. badia,* on the other hand, have a slow, heavy, blundering flight, keeping close to the ground as a rule, even when alarmed, and bumping into trees and bushes as they go. Once seen they may be caught with ease. Ricksecker (*17*) says that the males of *P. fimbriata* also have a heavy, blundering flight.

The females do not normally leave their tunnels, but merely open them to the surface. When they fall from their tunnels in steep banks they dig new holes immediately. The flying males are probably attracted to the females by scent. I have seen as many as nine males of *P. badia* scrambling about the open burrow of a female, each attempting to push the others away so that he could enter. Rivers (*22*) describes an instance of the male *P. behrensii* finding the female, apparently by scent. A female will mate with more than one male in the laboratory, although I am not sure that this happens in nature, as, after mating, the female burrows down into the ground from the pupal cell, filling in the hole behind her as she goes. Oviposition must take place deep in the ground, but of this nothing is known. I have kept mated females in the laboratory for three weeks or more and dissection at the end of that time showed that most of them had no matured eggs in their ovaries.

The attraction of males to light, as observed by Oscar Baron, is described by Rivers (*19*), and Kenneth Monroe, of Pasadena, Calif., told me of some "large brown bugs" flying into the fire during a rain at Pine Flats, near Pasadena. *Pleocoma badia* is not, however, attracted to automobile headlights, as I have failed

to capture them thus. Many males are attracted to pools of water, plunge into them, and drown. A light of low intensity, such as a lantern, a fire, or the reflection of light from the surface of water, is probably more attractive to them than is a stronger light.

Distribution

The genus *Pleocoma* has been found only in Oregon, California, Lower California, and possibly Utah. With two, or possibly three, exceptions the species are confined to California. The distribution of each species will be taken up in detail later. It is reasonable to suppose that the group is either a northern one, or a southern one that became acclimatized a long time ago. It is probable that before the last glacial period the insects became part of the fauna of what is now California and Oregon, and that, as the glaciers came southward, the beetles retreated before them. When the ice again retreated northward some of the insects followed it up, and others, going up the mountains to attain their optimum conditions, were left stranded in isolated spots and subsequently differentiated. This theory is partly supported by the fact that most of the northern species have a much wider distribution than those farther south.

(Continued in the January-April, 1935, issue of the "Bulletin")

BUTTERFLIES OF THE BOUNDARY HILL RESEARCH RESERVE, YOSEMITE NATIONAL PARK, CALIF.

By John S. Garth
University of Southern California

The Boundary Hill Research Reserve is an area approximately twenty-five square miles in extent which has been set aside by the administration of the Yosemite National Park for the study of wild life in the primitive state. The reserve takes its name from Boundary Hill, the only prominence designated on the topographical maps of the U. S. Geological Survey as included within its limits. On the south it is bounded by the north rim of Yosemite Valley, on the east by Yosemite Creek, on the north by the Tioga Road, and on the west by Cascade Creek. It was the privilege of Mr. Fred Ziesenhenne and myself, as members of the Yosemite School of Field Natural History, to spend five days, July 14 to 18, 1933, inclusive, collecting butterflies as our contribution to a general survey conducted by the twenty members of the class under the direction of Mr. Joseph Dixon, Field Naturalist, National Park Service.

While it is realized that relatively little may be accomplished in five days by two collectors, no matter how energetic, it is the belief of the writer that the evidence obtained is worthy of recording as a basis for a later and more detailed study. Arriving as we did at the height of the season we were able to take over forty species of diurnal Lepidoptera, including several not heretofore recorded for the Yosemite region, as well as larvae and pupae of several more.

The entire first day was consumed in reaching the temporary camp on the Tioga Road half a mile west of the Hetch-Hetchy trail, allowing ample time for observation and collecting. From the summit of Yosemite Falls, elevation 6,525 feet, the trail leads along the west bank of Yosemite Creek so that butterflies taken on either side were within the reserve area. The best catch was *Parnassius smintheus behrii,* the Rocky Mountain Parnassian which has invaded California via the Great Basin and which occurs again on Mt. Shasta. They were flying on a rugged and exposed talus slope half way between the summit of the falls and the fork of the trail to the Yosemite Creek Ranger Station. The only trees on the slide were sporadic Western Juniper, *Juniperus occidentalis.* The abundant flowering Stonecrop, *Sedum obtusatum,* had a particular attraction for the Parnassians, it being the larval plant food of the species. They had just begun to fly that morning, judging from their freshness and the fact that only two of ten specimens were females.

Other common trailside species occurring in less exposed situations were the Meadow Fritillary, *Brenthis epithore,* the Sierra Checker-Spot, *Euphydryas sierra,* the Northern Checker-Spot, *Melitaea palla,* and the rare Nivalis Copper, *Lycaena nivalis,* for which collectors are accustomed to hike to Glacier Point.

On the second and third days of the outing ascents were made of Research Ridge,[1] which rises 9,202 feet and which is topped by a few acres of Hudsonian Zone, the rest of the reserve being Canadian. We looked in vain for truly alpine species such as *Chionobas ivallda, Neominois ridingsii,* or *Melitaea malcolmi,* all of which are to be found on the ridge behind Mammoth Lakes or anywhere along the Sierran crest from Mt. Whitney to Lake Tahoe. The designation of the summit of the ridge as Hudsonian was based upon the presence of the Mountain Hemlock, *Tsuga mertensiana,* the Hudsonian White Crowned Sparrow, *Zonotrichia leucophrys,* and the Cony, *Ochotona schisticeps muiri,* rather than upon insect indicators.

The abundant butterfly on the east slope of Research Ridge was Hoffmann's Checker-Spot, *Melitaea hoffmanni.* So busily were they engaged sipping nectar from the Mountain Pennyroyal, *Monardella odoratissima,* that they might be netted by fives and sixes. The entire fourth morning was devoted to observation of the habits of this species with little collecting attempted. The Checker-Spot butterflies are known to feed in the larval stage upon members of the figwort family, *Scrophulariaceae,* of which there were two common members on this mountainside, *Pentstemon* and *Castilleja,* the latter being the food plant of the nearly related *Melitaea palla.* However, *hoffmanni* showed preference for neither. Recalling that one member of the genus at least, *M. neumoegeni,* chooses a composite, *Aster tortifolia,* which grows on the Mojave desert, we examined a small perennial of composite affinities, *Chrysopsis breweri.* On this plant were found larvae in about the third instar which were presumably *hoffmanni,* but failure of the food plant to survive at the lower elevation to which it was immediately transplanted prevented our rearing them successfully.

The Yosemite Blue, *Plebeius shasta comstocki,* was taken half way to the summit flying about the yellow buckwheat, *Eriogonum incanum.* On the rounded dome which has been cut into by a glacial cirque an *Astragalus, A. bolanderi,* joins the buckwheat; and wherever this combination occurs the Square-Spotted Blue, *Philotes battoides,* is not uncommon. It is not the true square-spot which occurs typically in Sequoia National Park but suggests race *oregonensis* B. & McD. even more strongly than those found in the Mammoth Lakes region. We believe that its occurrence on the reserve constitutes a new record for Yosemite.

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[1] Our designation. The ridge is three miles west of the temporary campsite mentioned in paragraph three.

The Sierran Parnassian, *P. clodius baldur,* flew throughout the reserve at altitudes from 6,525 to over 9,000 feet. Their choice for nectar was wallflower, *Erisymum asperum;* failing this they would alight on *Monardella.* Never were they found mingling with the other species, *P. smintheus behrii,* which dominates the open rock slides. In company with *baldur* and indistinguishable from it at a little distance was the California White, *Pieris sisymbrii.*

As we reached the higher elevations the mountain marbles, *Euchloe creusa hyantis* and *E. ausonides coloradensis* became increasingly abundant. Unlike the two species of Parnassians, the *Euchloe* fly over the same territory and may possibly interbreed. Most of our specimens are emphatically one or the other; a few show unquestionable affinities to both. These doubtful forms have been listed arbitrarily as *coloradensis,* it being the more plentiful species. At the very summit of Research Ridge it was possible to stand at a little gap between a lodgepole pine, *Pinus murrayana* and a rock pile and net the marbles as they passed. An invisible force impelled them to pass this point no matter in which direction they were headed. The same tendency has been observed with the desert species, *Euchloe creusa lotta* and *Anthocharis cethura,* on the buttes of the Mojave.

Several specimens of the elusive *Papilio indra* were observed at the summit of Research Ridge and again flying over the rocky territory of *Parnassius smintheus behrii.* It was the good fortune of Mr. Arthur Carthew to net the Short-Tailed Swallowtail near the top of the Yosemite Falls, giving us the record for the reserve and a second specimen for the Yosemite Museum. Drawing upon our knowledge of *P. indra* in the Huntington Lake Region[2] and *P. indra pergamus* in the Sierra Madre Mountains[3] we assume that *Sanicula nevadensis* of the dry hillsides is the acceptable plant food in this region.

Concerning the three plots selected by the class for intensive ecologic study we believe that any one of the species mentioned with the possible exception of those found on the very top of the ridge might conceivably stray within their confines. Actually, only one specimen was netted in Quadrat No. 1, *Euchloe creusa hyantis.* Quadrat No. 2 yielded *Parnassius clodius baldur.* The meadow of which Quadrat No. 3 is a part proved a more prolific field with the small blues, *Plebeius saepiolus* and *P. aquilo podarce* predominating. Several Hesperids, *Polites sonora, P. sabuleti tecumseh, Thorybes nevada,* and *Urbanus ruralis,* played about the *Horkellia* in the late afternoon. Plant foods of other species were also present: *Sisymbrium* for *Pieris sisymbrii,* and *Streptanthus tortuosus* a likely possibility for *Euchloe creusa hyantis,* judging from the fact that Mr. C. M. Dammers has taken larvae of the southern race *lotta* upon *Streptanthus inflatus.*

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[2] Bull. So. Cal. Acad. Sci., XXIX, 3, 1930, p. 117.
[3] Bull. So. Cal. Acad. Sci., XXVII, 3, 1928, pp. 82-86.

The most remarkable feature of the butterfly population of Research Reserve is the marked infiltration of Great Basin and Eastern-Sierran species, in particular *Parnassius smintheus behrii, Euchloe ausonides coloradensis, Thorybes nevada, Hesperia nevada,* and *Polites sabuleti tecumseh.* The writer knows of no other locality so far west of the Sierran divide in which these species occur. The reserve is then, not only the meeting place of two life zones, it is the frontier between two faunas, the Pacific or cismontane, and the Great Basin or desert-plateau. The Tioga Pass, elevation 9,941 feet, twenty miles to the east and one of the lowest passes in the Central Sierra, affords a comparatively easy entry from the Mono Lake region. The Pacific fauna, as the geographical position of the area would indicate, is dominant in number of species. However, in the one case in which there appears to be actual competition between two races of the opposing faunas, that of the *Euchloe,* the apparently more aggressive *coloradensis* presents the greater number of individuals. This fact may be offset by the possibility, deduced from the relative freshness of specimens, that *hyantis* is an earlier flier, reaching its peak before *coloradensis* is fairly started.

The Parnassians must not be considered as competitors for the same ecologic niche, as they occupy different associations. The glades of the fir forest are the habitat of *P. clodius baldur,* only the barren eastern slopes carrying the *Juniperus-Sedum-Sanicula* association being frequented by *P. smintheus behrii.* The several ridges paralleling Research Ridge and culminating in Mt. Conness, Dana, and Lyell of the Sierran divide present increasingly characteristic Mono Basin populations upon their arid eastern exposures. Whether these species are permanently established or disappear with a cycle of unfavorable years is problematical. It is the writer's opinion, after several seasons of observation of conditions in the Sierra, that the present ascendency of the desert fauna is directly correlated with the markedly reduced snowfall in recent years and the consequent aridity felt throughout the range. This conclusion is in keeping with the principle, worked out chiefly by the mammalogists, that while temperature is undoubtedly the most important single factor in delimiting zones, it is a change in humidity which erects the most formidable faunal barrier.[4] This being the case, a return to normal conditions of snowfall would be expected to check the invasion and dilute the desert-plateau population in the reserve area, while a cycle of wet years might bring about temporary eradication.

The answers to such problems will be found in the data accumulated by many surveys similar to this one, conducted regularly over a period of years and in a region like the Research Reserve in which the native flora and fauna are protected by wise administration from the encroachment of civilization.

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[4] Grinnell and Swarth, *An Account of the Birds and Mammals of the San Jacinto Area of Southern California.* Univ. Calif. Publ. Zool., X, 10, p. 217, 1913.

Butterflies of the Boundary Hill Research Reserve, Yosemite National Park—July 14-18, 1934

		♂	♀	Tot.
1.	Anise Swallowtail—*Papilio zelicaon* Luc.	6		6
2.	Indra Swallowtail—*Papilio indra* Reak.	1		1
3.	Baldur Parnassian—*Parnassius clodius baldur* Edw.	40	11	51
4.	Behr's Parnassian—*Parnassius smintheus behrii* Edw.	8	13	21
5.	California White—*Pieris sisymbrii* Bdv.	22	5	27
6.	Edward's Marble—*Euchloe creusa hyantis* Edw.	5		5
7.	Colorado Marble—*Euchloe a. coloradensis* Hy. Edw.	20		20
8.	Julia Orange Tip—*Anthocharis sara julia* Edw.	2		2
9.	Stellar Orange Tip—*Anthocharis sara stella* Edw.		1	1
10.	Boisduval's Sulphur—*Eurymus eurytheme* Bdv.		6	6
11.	Mountain Vagabond—*Argynnis montivaga* Behr	5	1	6
12.	Meadow Fritillary—*Brenthis epithore* Edw.	28	10	38
13.	Sierra Checker—*Euphydryas sierra* Wright	1	4	5
14.	Northern Checker—*Melitaea palla* Bdv.	21	4	25
15.	Hoffmann's Checker—*Melitaea hoffmanni* Behr	128	56	184
16.	Mountain Crescent—*Phyciodes montana* Behr	2		2
17.	The Zephyr—*Polygonia zephyrus* Edw.	1	4	5
18.	Virginia Lady—*Pyrameis virginiensis* Dru.	1		1
19.	Painted Lady—*Pyrameis cardui* L.		2	2
20.	West Coast Lady—*Pyrameis carye* Hbn.	2		2
21.	The Buckeye—*Junonia coena* Hbn.	1		1
22.	Boisduval's Hair Streak—*Habrodais grunus* Bdv.	1		1
23.	Nelson's Hair Streak—*Mitoura nelsoni* Bdv.	1		1
24.	Perplexing Hair Streak—*Callophrys perplexa* B. & Benj.	1		1
25.	Nivalis Copper—*Lycaena nivalis* Bdv.	12	7	19
26.	Varied Blue—*Lycaena heteronea* Bdv.	2		2
27.	Lotis Blue—*Plebejus melissa lotis* Lint.	1		1
28.	Gray Blue—*Plebejus aquilo podarce* F. & F.	27	11	38
29.	Greenish Blue—*Plebejus saepiolus* Bdv.	6	1	7
30.	Evius Blue—*Plebejus icarioides evius* Bdv.	3		3
31.	Yosemite Blue—*Plebejus shasta comstocki* Fox	1	1	2
32.	Acmon Blue—*Plebejus acmon* West. & Hew.		8	8
33.	Square Spot Blue—*Philotes battoides* Behr	22	27	49
34.	Dotted Blue—*Philotes enoptes* Bdv.	1	1	2
35.	Echo Blue—*Lycaenopsis pseudargiolus echo* Edw.	3		3
36.	Nevada Dusky Wing—*Thorybes nevada* Scud.	1		1
37.	Two Banded Skipper—*Urbanus ruralis* Bdv.	1		1
38.	Afranius Dusky Wing—*Erynnis persius afranius* Lint.	2		2
39.	Propertius Dusky Wing—*Erynnis propertius* Scud. & Berg.	4		4
40.	Nevada Skipper—*Hesperia nevada* Scud.		1	1
41.	Sonora Skipper—*Polites sonora* Scud.	2	1	3
42.	Tecumseh Skipper—*Polites sabuleti tecumseh* Grin.	5		5
			Total	564

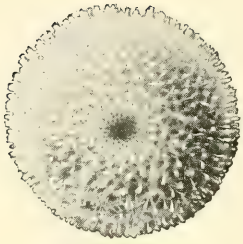

PLATE 40

Egg of *Strymon sylvinus*, superior surface, magnified x 37.

NOTES ON THE EARLY STAGES OF THREE BUTTERFLIES AND FIVE MOTHS FROM CALIFORNIA

By John A. Comstock and Charles M. Dammers

Strymon sylvinus Bdv.

Eggs were secured from a captive female collected at Riverside, Calif., in late June of 1931. In nature they are laid singly or in groups of two or three, on the stems of willow, and do not hatch until the following spring.

Egg: Size .8 mm. in diameter by .4 to .45 mm. high. Echinoid, the surface profusely covered with long spicules, except in the micropylar area. This gives the egg a velvety appearance.

There is a tinge of olive green or greenish mauve on the upper surface of the egg, but the predominant color is a soiled white.

The micropyle is strongly depressed and minutely pitted.

Plate 40 shows the superior surface of the egg.

Larva, first instar.

Color, pale green, sparingly speckled with light brown. There are four lines of long white hairs, one hair to each segment. A broad pearly-white line occurs on each side of the mid-dorsal area, and there is also a similar line along the infra-stigmatal fold.

All legs are a pale green. The abdomen is somewhat paler than the remainder of the body.

Head, black, and somewhat obscured by the long recurved hairs that arch over it from the first segment.

Second instar.

Slug shaped. Body ground color, pale green. First segment, pale blue-green. There is a lateral band of greenish-white, and a similar line traverses the infra-stigmatal fold, from both of which arise a row of long white hairs.

The body is covered with white pile.

Abdomen, pale blue-green. The cervical shield is a soiled white.

Head, colorless. with brown mouth parts.

In successive instars, including the last, the body color is pale apple green. There is a sub-dorsal thin white band running longitudinally from the second segment to the tail, which inclines inward as it approaches the caudal segments.

All segments except the first have two diagonal bars of white, crossing them laterally. Spiracles white. Infrastigmatal fold, lemon yellow. Legs, pale green with colorless points. Prolegs and anal prolegs, pale green with colorless claspers. The entire insect is covered with short white pile.

Head, colorless, with brown mouth parts. Ocelli, black.

The cervical shield is blue-green, with a white stripe down its center, and brown specks in the outer corners.

The mature larva when fully extended measues 19 mm.

It is illustrated on Plate 41.

Pupation takes place on the foodplant. The chrysalis is suspended from a silk button, and is supported by a delicate silken girdle.

PUPA: Length 9.6 mm.

Wing cases, thorax and head, pale olive-green, heavily marbled and spotted with dark olive-green. The body is pale greenish-brown, heavily spotted with brown on the dorsal aspect. There is a narrow dark mid-dorsal line on the thorax.

A broken pale brown band runs sub-dorsally on the thorax and body. First spiracle, white, and very conspicuous.

Head, thorax and body covered with white pile.

See Plate 41.

The single imago which was carried through emerged June 16, 1932, which confirms prior observations that the species is single brooded.

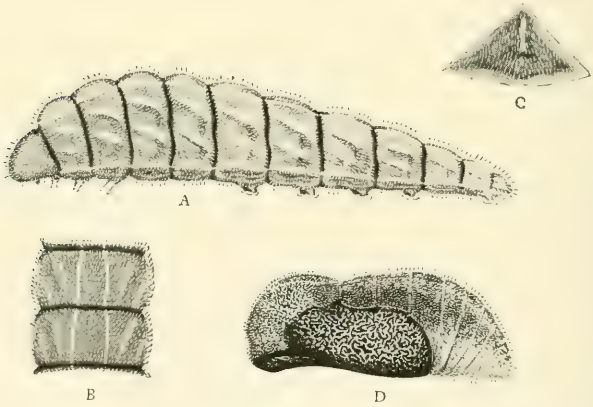

PLATE 41

Larva and pupa of *Strymon sylvinus*.

A. Larva, lateral view, enlarged x 3.3.

B. Two segments of larva, dorsal view, enlarged x 3.3.

C. Cervical shield of larva, highly magnified.

D. Pupa, lateral view, enlarged x 3.3.

HEMIARGUS GYAS Edw.

Eggs of this species were secured on September 21, 1931, on alfalfa, from captive females collected at Indian Wells, Coachella Valley, Calif. Oviposition has also been observed on Mesquite.

The eggs were laid singly on the foodplant, and hatched on September 24 and 25.

EGG: Size .5 mm. broad by .25 mm. high. Color, a delicate gray-green. The form is echinoid with a cupped upper surface, and a deeply depressed micropyle. The surface is covered with minute stout papillae or nodules, arranged in more or less regular diagonal lines, as is the case with the egg of *B. exilis*. See Plate 42.

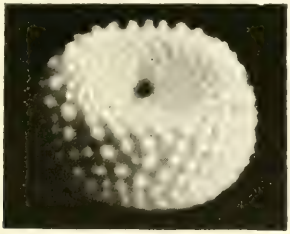

PLATE 42

Egg of *Hemiargus gyas*, magnified x 60.

Photo by Menke

LARVA, first instar; body color varying from pale green through deep green to light yellow and dark yellow. The usual long recurved colorless hairs were present. Legs and prolegs concolorous with body. Head, translucent black. Ocelli jet black.

In succeeding instars the color ranges from green, through a combination of green and mauve, to a solid mauve. Head black.

Mature larva; length, extended, .8 mm.

The same wide variation in body color persists in the final instar. Some are a solid pale green. Others show green, with a mauve sub-stigmatal fold. Still others have a mauve mid-dorsal band added to the last described combination. The latter form is used in our description.

There is a broad mid-dorsal band, edged laterally with yellow, which is interrupted at the segmental junctures. This mauve band is absent on the first and tenth segments.

Each segment, except the first, is crossed by two darker diagonal bands of green. The infrastigmatal fold (overlap) is yellow, with a mauve band above and below it.

Spiracles, white. All legs, pale green. Abdomen, pale green.

Head, black, and retractile.

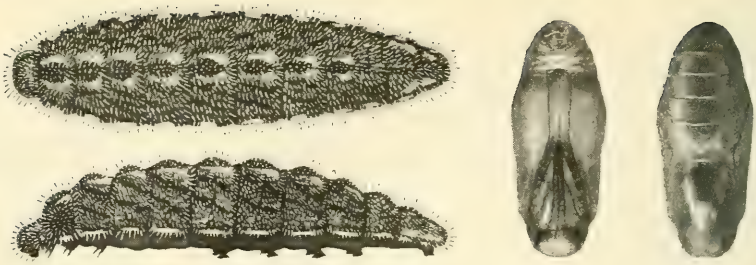

PLATE 43

Larva and pupa of *Hemiargus gyas*.
Figures at left, dorsal and lateral aspects of mature larva, enlarged x 7.
Drawing by Dammers

Figures at right, pupa, dorsal and ventral aspects, enlarged x 5.
Photo by Menke

The entire body is covered with short silvery-white pile.

The mature larva is illustrated on Plate 43.

The larva prefer to feed on the tender tips of the young shoots of their foodplant. Pupation occurs on the foodplant, suspended by a fine silken girdle. Our examples went into pupation from October 24 to 26, and the first imago emerged November 6.

PUPA: Length, 6.5 mm. Color, bright translucent green. Some examples show a slight mauve marking. There is a dark longitudinal line in the mid-dorsal area.

The form of the chrysalis is somewhat more elongate than is the case with others of the group.

The larva and pupa are illustrated on Plates 43 and 44.

PLATE 44

Pupa of *Hemiargus gyas*, lateral aspect, enlarged x 5½.

Drawing by Dammers

PHOLISORA CATULLUS Fabr.

Scudder's description and drawing of the egg of this species[1] varies considerably from examples observed in California. Whether this represents an actual difference, or is merely the interpretation of the artist remains to be determined.

[1] Scudder, S. H., 1889. Butterfl. of N. Eng. Vol. 2, p. 1521. Vol. 3, Pl. 66, Fig. 21.

Our examples show a lesser number of longitudinal ridges on the lower half of the egg, and the roughened upper expanded continuations of these are more pronounced and relatively longer. The body of the egg is a light shade of chocolate, and the expanded ridges are pinkish white. These features are accurately brought out in Plate 45.

The larva and pupa have been described in great detail by Scudder, and also by W. H. Edwards.[2]

PLATE 45

Egg of *Pholisora catullus*, greatly magnified.

EUPROSERPINUS PHAETON G. & R.

The larva of this species was evidently known to W. G. Wright, and perhaps some of the other early California entimologists. Unfortunately they published no records concerning it.

The imago has always been considered a rarity until the writers found its breeding ground in the Gavilan Hills near Riverside, early in 1931.

Dr. E. R. Hulbirt of Glendora was the first of our local collectors to note the foodplant, *Oenothera bistorta* Nutt., and, as a result of his observation, we were able to secure eggs and larvae.

The first of these were taken by the junior author on March 23, 1931, which made possible the following observations on the metamorphosis.

EGG: Size .9 mm. wide by 1.2 mm. long.

Oval, the surface smooth, with no visible micropyle.

Color, glistening deep green.

Young larvae of the first and second instars: Body color a soiled yellow, covered with whitish dots, and a few black specks. Head black. See Plate 46.

PLATE 46

Young larva of *Euproserpinus phaeton*, enlarged.

Drawing by Dammers

[2] Edwards, W. H., 1885. Can. Ent. Vol. 17, p. 245.

In subsequent instars the body assumes a green or pink shade, with the characteristic markings of the mature larva.

LARVA, last instar: Average length 30 mm. Cylindrical, the head relatively large. There is considerable variation in color, ranging from a predominance of green, to pink. All of the color variants are admirably adapted to the larval environment from the standpoint of protective coloration.

The body bears a mid-dorsal band of green which widens out at the segmental junctures, with dark mauve patch in its center.

From this band in the center of each segment extends a yellow Z-shaped band on each side. There is a longitudinal yellow lateral band bearing, at each segmental joint, a dark mauve patch on its upper edge. The space between the longitudinal yellow band and the mid-dorsal green band is light mauve.

A broad supra-stigmatal band of pale green is present, and is bordered superiorly by a broken mauve band, and inferiorly by a slightly darker mauve edging.

Superior to each spiracle is an irregular prominent patch of mauve.

The infra-stigmatal fold is white.

The short caudal horn arising in the median line from the 11th segment is light mauve.

Abdomen pink, studded with white; the segmental junctures green.

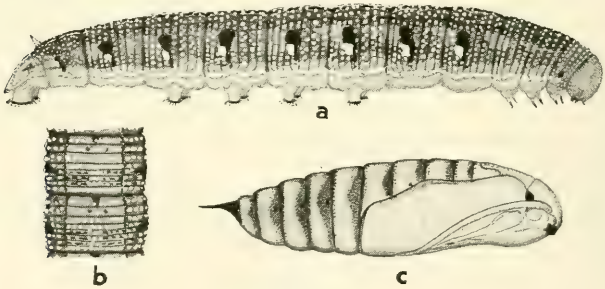

PLATE 47

Larva and pupa of *Euproserpinus phaeton.*

a. Lateral view of mature larva, enlarged x 2½.
b. Two typical segments of larva viewed dorsally.
c. Pupa, lateral aspect, enlarged x 2½.

Drawing by Dammers

Spiracles, orange, encircled with a black rim.

True legs, pink, with black tips. Prolegs and anal prolegs, pink, with light brown claspers.

Head, pale mauve, covered with a fine white pile. Mouth parts and ocelli black.

The entire body of the larva is thickly studded with raised white punctae. The shape and markings of the mature larva are accurately pictured in Plate 47.

The green form of the larva is similar in markings but the pink and mauve coloration is everywhere replaced with green.

PUPA: Length, 18 mm. Color, a uniform pale chestnut. The wing cases are semi-translucent; cremaster, long and tapering. The form is accurately shown on Plate 47, fig. *c,* and obviates the necessity of a lengthy description. Pupation occurs under any object on the ground, where the larva forms a depression on the top of the soil. The pupa overwinters, and there is only one brood a year.

SIMYRA HENRICI Grt.

The metamorphosis of this widely distributed species has been in part described by a number of writers. Smith and Dyar record the last two larval instars, the cocoon and pupa (as *Arsilonche albovenosa*) in the Proceedings U. S. Nat'l. Mus., Vol. 21, p. 176.

Since no adequate illustrations occur in the literature we are showing figures of the larva and pupa on Plates 48, 49 and 50.

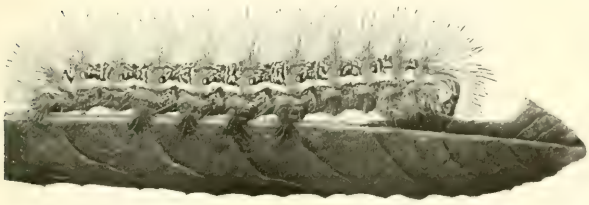

PLATE 48

Larva of *Simyra henrici* feeding on willow.

Photo by Menke

Larvae were collected on cat-tails and sedges by the senior author, at Playa del Rey, Calif., some years ago, and more recently were furnished the junior author by Master McDermont of Riverside. The latter were taken near Westminster, Orange Co., Calif., feeding on willow. Grasses and smartweed have also been listed as foodplants.

The imago was determined through the courtesy of Dr. J. McDunnough of Ottawa.

The larvae are lightly parasitized in this region by a Tachinid.

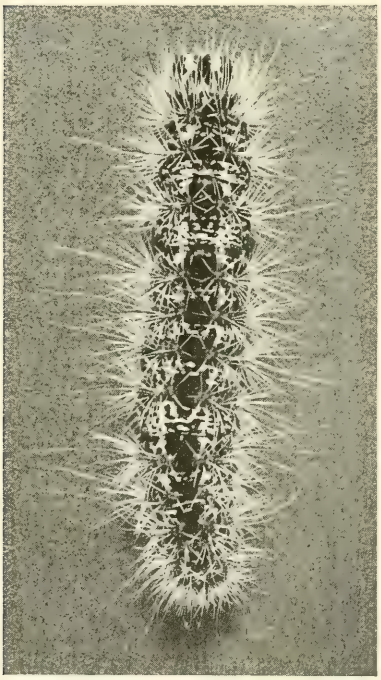

PLATE 49

Larva of *Simyra henrici*, dorsal aspect, enlarged x 2.

Photo by Menke

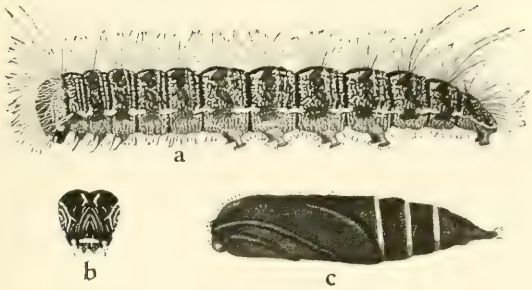

PLATE 50

Larva and pupa of *Simyra henrici.*

a. Mature larva, lateral aspect.

b. Front view of head of larva.

c. Pupa, lateral aspect.

All figures enlarged x 1½.

Drawing by Dammers

CATABENE ESULA Druce.

This moth has, of late years, been taken in progressively increasing numbers in the cities and towns of southern California, doubtless as a result of the increased planting of Lantana as an ornamental hedge in parks and gardens. In a state of nature it probably feeds on native members of the *Verbenaceae.*

Through the courtesy of Mr. Chris Henne of South Pasadena we were presented with eggs of this species which made possible the following notes on its metamorphosis.

EGG: Hemispherical, the base flat: micropyle small and slightly depressed. Height about three-fourths of the diameter at base. Color, light cream, with a few irregular light brown spots which seem to be buried in the substance of the egg. The surface is covered by a cross-hatching of ridges, of which there are about 25 running vertically, crossed by about 12 in the horizontal plane. The egg is illustrated in Plate 51.

PLATE 51

Egg of *Catabene esula,* viewed laterally, under high magnification.

Drawing by Comstock

The eggs were laid by a captive female, on October 27 to 29, 1934. Of the five examples under observation all were carried through to pupation. The first pupa was formed November 25 and the last, November 29.

Larvae had also been secured on Lantana earlier in the year by Mr. Karl Christian, from which imagos were produced September 16, and a prior laboratory record gives June 21 as the date of emergence of a single moth in Riverside. It is evident from these dates, and from labels in our collections, that *Catabene esula* is a continuous breeder throughout practically the entire year.

The newly emerged larvae are cylindrical, with a slightly flattened head. Two days after emergence they show a greenish brown color, with several poorly defined longitudinal brown lines. The head is yellow brown. The first moult was passed November 6 and 7, after which the body color was gray, and the brown stripes more clearly defined. These stripes are arranged in pairs, with three pairs on each side of the median dorsal area above the infrastigmatal fold. The dorsal pair are dark brown, the dorsolateral pair light brown.

The third pair are separated by the stigmata, and the one above the stigmatal area is lighter than the one below. Some of these lines continue forward on to the head of the larva.

Stigmata, light, with narrow dark rims.

On the 11th segment there is a slight protrusion in the median line, presaging the later dorsal tubercles.

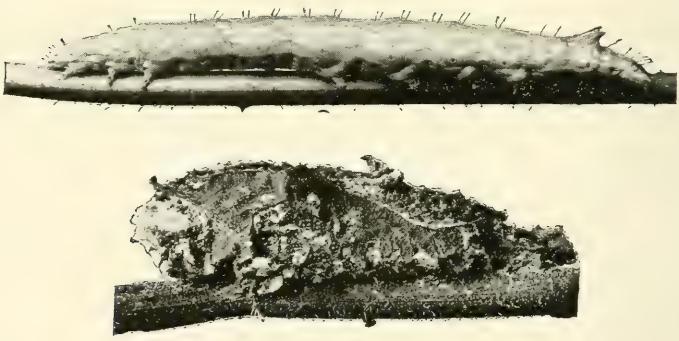

PLATE 52

Larva and cocoon of *Catabene esula.*

Upper figure, mature larva, enlarged x 1 3/5.

Lower figure, cocoon, enlarged x 1 3/5.

Photo by Menke

Head concolorous with body, as are also the legs and prolegs. The anterior two pairs of prolegs are almost rudimentary and only semi-functional in this, and also in the first instar, while the posterior two pair are unusually well developed.

A number of short black vibrissae occur over the body, arising from black papillae. Shorter and light colored hairs are also sparsely present over the anterior part of the head.

Measurement at the termination of this instar, 9.5 mm.

The second moult occurred on November 9 and 10, with very little change in the markings. The ground color assumed a slightly more olive cast, and the dorsal hump on the 11th segment appeared somewhat larger. From this point to the final instar we were unable to record the changes.

LARVA, last instar. Length, extended, 50 mm. Ground color, buff. There is a broad mid-dorsal band, of a slightly darker shade than the ground color, which bears three irregular thin buff lines, traversing its entire length.

The overlap is also slightly darker than the body.

The 3rd and 4th segments appear as a single segment. From the 11th segment there arises a prominent hump, surmounted by two dark pointed processes.

Stigmata, dark brown. Legs, buff. Prolegs and anal prolegs, dark buff.

Abdomen, buff.

Head, buff, with a few white hairs on the anterior portion. Mouth parts brown.

The larva, when not feeding, assumes a fully extended position along the stem of the plant, giving it complete camouflage. Plate 52 accurately depicts the mature stage.

Pupation takes place on the food-plant in a cocoon formed by the drawing together of several leaves. A typical cocoon is shown on Plate 52. In a few cases the larvae pupate on top of the ground, incorporating particles of debris and soil in their firmly woven cocoon.

PUPA: Length 16 mm. Greatest width through thorax, 5 mm. General color, red-brown, with a darker brown on the dorsal aspect.

The chrysalis is smooth on the ventral and lateral surfaces, and markedly rugose on the dorsum. The cremaster is formed of four short pyramidal nodules, without hooks.

Stigmata, darker brown than the surface on which they rest. There are no visible hairs or vibrissae on any portion of the pupal surface. See Plate 53.

PLATE 53

Pupa of *Catabene esula*, enlarged x 2¼, showing lateral, ventral and dorsal aspects.

Photo by Menke

LITOCALA SEXSIGNATA Harv.

Larvae of this species were collected at Lebec, Calif., on June 11, 1933, on Quercus. They were at first thought to be of two distinct species, since the immature forms were quite different from the mature. No notes were made of the earlier instars, but a photograph was made which is shown on Plate ..... When these young larvae assumed their final instar it was determined that they were the same species as the larger larva collected at the same site. The mature larva may be described as follows:

Last Instar: Length, 33 mm. Cylindrical, tapering toward the tail. The body color is a light gray, on which is superimposed numerous dots, dashes and lines, of black and brownish black.

There is a broad dark dorsal band, edged outwardly by a zigzag black line. This line is composed of irregularly angular dashes, one angle to a segment, the apex pointing laterally at the

middle of the segment, and the tips meeting with adjacent angles closer to the median area. Between these zig-zag lines is a broad area covered with black dots and broken lines arranged more or less in longitudinal rows. Lateral to these black angulated lines is a lighter area, marked and marbled much as is the mid-dorsal.

The lateral and substigmatal region is slightly darker than the last described area, and is striped longitudinally by the same character of broken lines, dots and dashes.

There are a number of black punctae scattered over the body (some slightly raised) which give rise to colorless hairs. These hairs do not show in the figure, Plate 54, on account of their transparency.

Legs, brownish gray; prolegs and anal prolegs concolorous with the body. The anterior two pair of prolegs are smaller than

a

b *c* *d*

PLATE 54

Larva and pupa of *Litocala sexsignata.*

a. Young larva, enlarged.

b. Mature larva, enlarged.

c. Pupa, dorsal aspect, enlarged x 3½.

d. Pupa, ventral aspect, enlarged x 3½.

Photo by Menke

the posterior. The anal prolegs are protruded posteriorly, and are relatively long and narrow.

Head gray, with a black reticulated network of spots and dashes.

When disturbed the larva throws itself violently from side to side in a series of jerks. Thereafter it frequently "plays possum" in a semi-curved posture, as shown in the illustration.

Pupation occurred on the floor of the breeding cage. In a state of nature they probably go under ground.

PUPA: Length, 15 mm. Color, a uniform red-brown. The pupa is stoutest through its anterior half, and tapers rather abruptly at the last caudal segments. The surface is finely granular, and there are no hairs or protuberances under low power observation.

Spiracles, elongate, concolorous with body.

Cremasteric hooks four in number, two being long, and two very short, as will be noted in the illustration, Plate 54.

Two imagos emerged February 15, 1934. The species is diurnal, and is exceedingly common in certain years throughout the oak belts of the southern California mountains. It ranges as far east as Colorado.

TITANIO DAPALIS Grt.

A quantity of the eggs of this species were secured from a captive female collected in the Gavilan Hills near Riverside, Calif. They were laid on March 13, 1932. The eggs are deposited singly on the leaves and flowers of the foodplant, which is *Salvia columbaria* Benth. (Chia.).

Larvae were also collected in the fall of 1931, near Phelan, San Bernardino County, feeding on the same plant.

EGG, ovoid; pale green, almost colorless.

No notes were made of the larva in its earlier instars, but drawings, and the following description of the last instar, will serve as a starting point for later and more complete studies.

MATURE LARVA. Length, extended, 15 mm.

Body ground color a translucent pale olive green. There is a longitudinal greenish white line on each side of the mid-dorsal area, and a similar line occurs above the infra-stigmatal fold.

Ten raised black punctae are present on each segment, except the first, from each of which arises a single long pale brown hair. The black puncta occurring above each spiracle is elongated horizontally and is slightly crescentic.

On the thoracic segments, however, these punctae are round.

The first segment has a band of small raised black points across its center, with long pale brown hairs arising from them and arching over the head.

The infra-stigmatal fold is concolorous with body. Legs, colorless, spotted with brown.

Prolegs and anal prolegs, pale green with brown claspers.

Spiracles, pale green with black rims. Abdomen, greenish white.

Head, pale brown, speckled with darker brown and bearing a sparse covering of colorless hairs.

Mouth parts and ocelli, dark brown. The mature larva is illustrated in Plate 55.

The larva weaves a very secure flattened cocoon on the food-plant, in which pupation occurs. The spring brood pupates in April. One example remained in its cocoon without casting its larval skin until October.

PUPA: Average length, 8 mm. Color, pale chestnut, with the head, thorax and spiracles darker. The accompanying cut, Plate 55, fig. *c*, gives the correct form, rendering further description unnecessary.

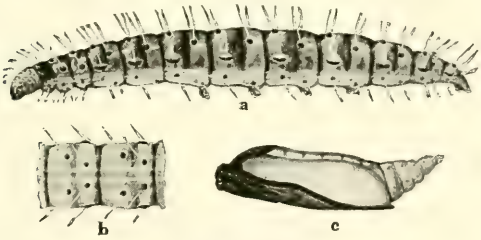

PLATE 55

Larva and pupa of *Titanio dapalis*.

a. Mature larva, lateral view, enlarged x 4.
b. Two typical segments, viewed dorsally.
c. Pupa, lateral aspect, enlarged x 4.

Drawing by Dammers

A REVISION OF THE PHACELIA CALIFORNICA GROUP (HYDROPHYLLACEAE) FOR NORTH AMERICA

By Frederick W. Dundas

This study has been undertaken at the suggestion of Dr. Philip A. Munz, of Pomona College, to whom I am deeply indebted for his kind assistance and guidance. I wish also to thank Dr. W. L. Jepson of the University of California for kindly lending several types from his private herbarium and Dr. H. A. Gleason of the New York Botanical Garden for the loan of several types. I am indebted also to Dr. Ivan M. Johnston of Harvard University for helpful advice, to Prof. Morton E. Peck of Williamette Univ. for specimens, and to Mrs. Elizabeth Crow Norland of the University of California for looking up references.

During the course of this study material has been available from the following herbaria: Gray Herbarium of Harvard University (G); Rancho Santa Ana Herbarium (SA); Pomona College Herbarium (P); and some from New York Botanical Garden (NY). I wish to express my appreciation to the curators of these herbaria for kindly lending their material. The abbreviations expressed in parentheses are used in citing specimens.

Due to the extreme variability and lack of distinguishing characters in this group an attempt was made to find new floral characters which would help in separating various entities. To that end camera lucida drawings were made of floral parts of the various entities that have been proposed. Such work, however, failed to reveal morphological characters that have not already been used, and external floral and vegetative characters have had to be employed.

It does not seem necessary here to go into a discussion of the history of the taxonomy of this group of species, since it was quite adequately discussed as late as 1917 by Macbride (Cont. Gray Herb, n. s. 49:31). The only very significant treatment since then is by Jepson, Man. Fl. Pls. Calif., 816. 1925. The present study results in a classification not markedly different from the two above mentioned, but since, in certain cases, it has perhaps been possible to secure improvement in using more tangible distinguishing characters, it seems worthwhile to put this on record.

Key To Species

Basal leaves grouped in a dense cluster; cauline leaves either present or absent.

Filaments villous.

Leaves having one to four pairs of lateral leaflets at base, very rarely all entire; plants covered with a hispid or hispidulous, never sericeous, pubescence.

Calyx lobes with a hispid, glistening, greenish-yellow, rarely white pubescence .....1. *P. heterophylla.*

Calyx lobes with a dull, white, never glistening pubescence .....2. *P. californica.*

Leaves all entire (basal pinnatifid in var. *compacta*); plants covered with a closely-appressed, sericeous pubescence (except var. *alpina*), often somewhat hirsute .....3. P. *leucophylla.*

Filaments glabrous; plants reduced, not exceeding 20 cm. in height .....4. *P. dasyphylla.*

Basal leaves not grouped in a dense cluster; leaves mostly cauline .....5. *P. pinnata.*

Treatment of Species

✓ 1. Phacelia heterophylla Pursh, Fl. Am. Sept. 1:140. 1814.

Plants biennial or perennial, 1 to 8 dm. high; stems usually erect, one to several from base, slender to very stout, covered with a stiff spreading pubescence; leaves 1.5 to 9 cm. long, orbicular to ovate to linear-lanceolate, with one to three pairs of lateral leaflets at the base, rarely entire, the pubescence rather appressed-hispidulous, not sericeous; basal leaves usually densely rosulate and the leaves of the stem mostly scattered and well-developed; inflorescence virgate to spreading; lobes of the calyx linear to linear-lanceolate, thickly beset with a hispid, spreading or subappressed, glistening, usually greenish-yellow or rarely white pubescence; corolla exceeding calyx; stamens long-exserted, twice the length of the corolla; filaments villous.

This species is distinguished from *P. californica* by the glistening, yellowish, hispid pubescence on the calyx-lobes, whereas this pubescence in *P. californica* is usually white in color and always dull, lacking the glistening or shining appearance.

Key to Varieties

Terminal segment of leaf not rotund nor orbicular-elliptical.

Plants 1.5 to 8 dm. high; stems usually stout, 1.5 to 10 mm. in diameter .....1a var. *typica.*

Plants much reduced, 0.5 to 2 dm. high; stems slender, 0.75 to 1.5 mm. in diameter .....1b var. *frigida.*

Terminal segment of leaf rotund or orbicular-elliptical.....

.....1c. var. *rotundata.*

1a. *Phacelia heterophylla* Pursh, var. *typica,* n. nom. *P. heterophylla* Pursh, Fl. Am. Sept. 1:140. 1814; *P. magellanica* (Lam.) Cov., f. *heterophylla* (Pursh) Brand, Univ. Cal. Publ. Bot. 4:218. 1912; *P. magellanica* (Lam.) Cov., f. *griseophylla* Brand, 1. c.; *P. heterophylla* Pursh, var. *griseophylla* (Brand) Macbride, Cont. Gray Herb., n. s. 49:35. 1917; *P. heterophylla* Pursh, var. *grisophylla* Jepson, Man. Fl. Pls. Calif., 819. 1925; *P. heterophylla* Pursh, var. *compacta* Jepson, 1. c.; *P. hastata* Dougl. ex Lehmann, Nov. Stirp. Pugill. 2:20. 1830; Hooker, Fl. bor. Amer. 2:80. 1838; *P. biennis* A. Nels., Bull. Torr. Club 26:132. 1899.

Plants 1.5 to 8 dm. high; stems usually stout, 1.5 to 10 mm. in diameter.

Type locality: "On the banks of the Kooskooskie" (Idaho) —Ranging from Montana to New Mexico, California and Washington. Material examined: MONTANA: Phillipsburg, *Titcomb in 1884* (G); Spanish Basin, *Rydberg & Bessey 4850* (G); Bridger Mts., *W. W. Jones in 1902* (G); Alta, *Jones in 1909* (P); Mt. Bridger, *Blankinship in 1906* (P); Ravalli, *Clemens in 1908* (G). IDAHO: Hatwai Creek, *Sandberg, MacDougal & Heller, 174* (G); Johnson's Bar, *St. John 4490* (P); Lewiston, *A. A. & E. Heller in 1896* (P); Red Rock Pass, Leonard in 1885 (G); Salmon, Payson 1770 (G); Silver City, *Macbride 377* (G); Deadwood Creek, *Nelson & Macbride 1848* (G); Pinehurst,, *Macbride 1661* (G, P); Picabo, *Macbride & Payson 3000* (G); Forks of St. Mary's River, *Leiberg 1159* (G, P). WYOMING: Pole Creek, *Nelson 1323,* type coll. of *P. biennis* (G), photograph (P). COLORADO: Golden, *Churchill in 1918* (G), *Johnston 391* (G), and *Jones 253* (P); Gould Creek, *Blumer in 1903* (G); Pagosa Springs, *Baker 548* (G, P); Empire, *Patterson 249* (G); Rist Canyon, *Marshall 1611* (G); Mancos Canyon, *Baker, Earle, & Tracy 308* (G, P); Lyons, *Johnston in 1916* (G); Cimarron, *Baker 401* (G, P); Rabbit Ear Range, *Goodding 1592* (G); Paradox, *Walker 231* (G); Roswell, *Biltmore Expedition 3113* (G); Steamboat Springs, *Baker in 1894* (P). UTAH: Juab, *Goodding 1065* (G); Springdale, *Jones 5249* (P); Ellen Henry Mts., *Jones 5684* (P); Wasatch Mts., *Garrett 1013* (G); Fort Douglas, *Clemens in 1908* (G); Silver Lake, *Rydberg & Carlton 6636* (G); La Sal Mts., *Payson 3940* (G). NEVADA: Carson City, *Anderson in 1865* (G); Kings Canyon, *Baker 1040* (G, P); East Humboldt Mts., *Jones in 1897* (P). NEW MEXICO: James Canyon, *Wooton in 1899* (P); Lake Peak, *Arséne in 1926* (P); Tularosa Creek, *Wooton in 1899* (G); *Cloudcroft, Eggleston 14530* (G); White Mts., *Wooton 291* (G), *Fendler 642* (G); Winsor's Ranch, *Standley 4140* (G), *Wright in 1851* (G). ARIZONA: Kaibab Forest, *Jaeger in 1926* (P); Flagstaff, *Jones in 1884* (P); Metcalf, *Davidson 504* (G); Thompson Ranch, Goodding 547 (G); Huachuca Mts., *Jones in 1903*

(P). CALIFORNIA: Soda Springs, *Jones 201* (P); Round Meadow Camp, *Grant in 1902* (P); Lake Tenaya, *Smiley 868* (G); Sacramento River, Shasta Co., *Heller 12445* (G); Lambert's Dome, *Smiley 760* (G); Emigrant Gap, *Jones 2813* (P); Ragged Peak, *Smiley 834* (G); Tuolumne Meadows, *Ware 2660* (G); Redwood Belt, Humboldt Co., *Chandler 1257* (P); Kaiser Crest, *Smiley 627* (G); Angora Peak, *Smiley 301* (G); Camp Agassiz, *Pendleton and Reed 1297* (P); Marble Mt., *Butler 408* (P); Donner Lake, *Heller 6883* (P); Sierra Co., *Lemmon in 1874* (G). OREGON: without locality, *Spalding* (G); Keno, *Peck 9338* (G); Waldo, Josephine Co., *Thompson 4604* (G), *Howell 1884* (G); Agness, *Nelson 1499* (G); Cascade Mts., *Lyall 1859* (G); Steins Mts., *Leiberg 2548* (G); Port Orford, *Peck 8432* (G); Cottage Grove, *J. C. Nelson 2643* (G); Mt. Hood, *Jones in 1897* (P); Iron Mt., *Eggleston 22176* (G); John Day River, Sherman Co., *Henderson 5359* (G); Wallowa Lake, *Thompson 4821* (G); Pilot Butte, *E. Nelson 852* (G); Dalles, *Luvell in 1903* (G); Pendleton, *Jones in 1905* (P); La Grande, *Thompson 4760* (G); Clear Water, *Spalding* (G). WASHINGTON: without locality, *Vasey 412* (G); Hay Creek, *Leiberg 208* (G, P); Pullman, *Elmer in 1896* (P); Mt. Stuart, *Thompson 5851* (G); Mt. Rainier, *Thompson 5446* (G); Waitsburg, *Horner 3352* (G); Walla Walla, *Jones in 1905* (P). BRITISH COLUMBIA: Chilliwack Valley, *Macoun 54327* (G); Cameron River Valley, Vancouver Island, *Rosendahl 1996* (G).

In my opinion, the distinction given by Macbride to the forms with a spreading inflorescence is unworthy even of varietal recognition. It must be remembered that this group is exceedingly variable, and consequently these specimens which vary from the strictly virgate form may be regarded merely as variants due perhaps to ecological conditions such as shade or moisture.

✓ 1b. PHACELIA HETEROPHYLLA Pursh, var. FRIGIDA (Greene) Jepson, Man. Fl. Pls. Calif., 819. 1925. *P. frigida* Greene, Pitt. 4:39. 1899; *P. heterophylla* Pursh, f. *frigida* (Greene) Macbride, Cont. Gray Herb., n. s. 49:35. 1917; *P. magellanica* (Lam.) Cov., f. *frigida* (Greene) Brand, Univ. Cal. Publ. Bot. 4:218. 1912; *P. californica* Cham., f. *immunda* Macbride, Cont. Gray Herb., n. s. 53:18. 1918; *P. magellanica* (Lam.) Cov., f. *ferruginea* Brand, Pflanzenreich IV. 251:100. 1913.

Plants much reduced, 0.5 to 2 dm. high; stems rather slender, erect or ascending, 0.75 to 1.5 mm. in diameter.

Type locality: Mt. Shasta, California—Ranging from central California into Washington and British Columbia. Material examined: CALIFORNIA: White Mts., *Duran 562* (SA); Rae Lake, Fresno Co., *Clemens in 1910* (P); Cathedral Peak, *Smiley 818* (G); Mt. Tallac, *Smiley 245* (G), *Abrams 4841* (G); Suzy Lake, *Smiley 152* (G); Red Mt., Mendocino Co., *Eastwood*

in 1901, type of *P. magellanica,* F. *ferruginea* Brand, (Univ. Calif. Herb.); Mt. Eddy, *Heller 12486* (G), *Baker 3821* (G, P); Del Norte Co., *Eastwood 226* (G); Mt. Shasta, *Baker 3920* (G). OREGON: Mt. Hood, *Howell 198* (G), *Thompson 5009* (G), *Barber 213* (G); Agness, *J. C. Nelson 1470,* type of *P. californica* Cham., f. *immunda* Macbride (G). WASHINGTON: Mt. Rainier, *Cowles 790* (G). BRITISH COLUMBIA: Mt. Arrowsmith, Vancouver Island, *Carter in 1917* (G).

The only differentiating character for this variety is its reduced form. However, it seems to run quite true in this one character and thus to deserve varietal distinction.

Macbride's *P. californica,* f. *immunda,* described from a single collection is obviously synonymous with this variety. It posesses the yellowish, glistening calyx-pubescence of *P. heterophylla,* and the habit of var. *frigida.*

P. dasyphylla Greene var. *ophitidis* Macbride (Contr. Gray Herbarium, n. ser., 59:32. 1919) was also described from a single collection. Its chief distinguishing character seems to be its glabrous stamens, and it was upon the basis of this character that Macbride made it a variety of *P. dasyphylla.* Through the kindness of Professor Peck of Williamette University I have had material from southern Oregon, but only the type collection itself lacks pubescence on the filaments. The habit and general characteristics of the plant resemble those of *P. heterophylla* var. *frigida* much more closely than of *P. dasyphylla.* Since the glabrous stamens have been found in the type collection only and may have occurred as a factor mutation in but a single individual, the entity at present seems at most to be a very minor one, and I here propose P. heterophylla Pursh var. frigida Jeps, forma ophitidis (Macbr.) n. comb.

1c. *Phacelia heterophylla* Pursh var. *rotundata* n. var.

Stem erect, leafy, densely pilose, 4-5 mm. in diameter; leaves long-petioled, the blades unusually thick, very densely appressed-hirsute, lateral veins pinnately arranged and deeply impressed, the tips mucronate, leaves usually with one pair of lateral lobes at the base, terminal segment 2.5-3 cm. long, orbicular-elliptical; lateral segments similar but much smaller. (Caulis erectus, dense pilosus, 4-5 mm. crassus, 1-3 dm. altus; foliis inusitate crassis, longe petiolatis, laminis dense appress-hirsutis, mucronatis, cum venibus lateralibus profunde signatis; lobis lateralibus 2; segmento terminale 2.5-3 cm. longo, rotondo aut orbiculare-ellipticale; segmentis lateralibus similibus sed multe parvis).

Type, Lake Earl, Del Norte Co., California, *J. Burtt Davy* in *June, 1902* (Pomona College Herbarium No. 127635). Although known from but a single collection, this variety seems to represent so distinct an entity that I have been unable to refer it to any hitherto recognized entity. It is characterized by the thickness and roundness of the leaf-segments, the very dense

appressed pubescence on the leaves, and the extremly deep impression of the lateral veins of the upper surface of the leaves.

2. PHACELIA CALIFORNICA Cham., Linnaea 4:494. 1829.

Plants perennial or sometimes biennial, 1.5 to 8.5 dm. high; stems one to several from base, usually erect, covered with a stiff spreading or partly subappressed pubescence; basal leaves densely rosulate, cauline scattered, the blades of both linear-lanceolate to elliptic-ovate, acute, 2 to 6 (8) cm. long, with 1 to 4 pairs of lateral leaflets at the base, covered with a short, matted, fine, white pubescence and long, mostly scattered, appressed, stiff white hairs; inflorescence spreading to virgate; calyx-lobes narrowly linear to broadly ovate, covered, especially on the margins and mid-rib, with a dense, dull, white, spreading pubescence; corolla blue, yellow, or white, exceeding the calyx; stamens long-exserted, the filaments villous.

KEY TO VARIETIES

Calyx-lobes elliptic-lanceolate to ovate.
- Calyx-lobes imbricated, broadly lanceolate to ovate, corolla white to yellowish ..... 2b. var. *calycosa*

Calyx-lobes not imbricated, somewhat narrower. Corolla blue; dried plants brownish-green in appearance. San Francisco Bay region ..... 2a. var. *typica.*
- Corolla yellow or white; dried plants grayish-green in appearance. Southern California ..... 2c. var. *bernardina.*

Calyx-lobes linear or linear-lanceolate.
- Inflorescence strictly virgate. Northern California ..... 2d. var. *virgata.*
- Inflorescence not strictly virgate, but more or less spreading. Corolla blue or bluish-white, leaves densely white-hairy ..... 2e. var. *jacintensis.*
- Corolla not blue, leaves not white-hairy.
  - Basal leaves mostly 3 to 10 mm. wide, cauline leaves not much reduced. Southern California.... 2f. var. *patula.*
  - Basal leaves 8 to 20 mm. wide, cauline leaves few and much reduced. Central and Northern California ..... 2g. var. *egena.*

2a. *Phacelia californica* Cham., var. *typica,* n. nom. *P. californica* Cham., Linnaea 4:494. 1829; *P. magellanica* (Lam.) Cov., f. *californica* (Cham.) Brand, Univ. Cal. Publ. Bot. 4:218. 1912; *P. magellanica,* f. *Jepsonii* Brand, Pflanzenreich IV. 251:100. 1913.

Stems usually solitary from base, stout, 3 to 7 mm. in diameter, erect, not exceeding 6 dm. in height; leaf blades ovate-lanceolate to elliptic-ovate, with one or two pairs of lateral leaflets at the base, characteristically brownish green in appearance; calyx-lobes narrowly elliptic-lanceolate; corolla blue or purplish-blue.

Type locality: not given—Ranging through the San Francisco Bay region, California. Material examined: Crystal Springs Lake, *Elmer 8455* (P), *Baker 690* (G, P); San Bruno

Hills, *Heller 8460* (G), *Baker 1901* (G, P); Sandhills near San Francisco, *Baker 2841* (G, P); Lake Merced, *Heller 5701* (G, P); Oakland, *Jones in 1882* (P); Olema, *Harriet A. Walker 1354* (P); Mt. Tamalpais, *Heller 8405* (G); Mission Hills, *Michener & Bioletti 99* (G); Bodega Point, *Eastwood 4841* (G); Murphy's, *Bigelow in 1854* (G).

2b. *Phacelia californica* Cham., var. *calycosa* (Gray). n. Comb. *P. circinata* (Willd.) Jacq., var. *calycosa* Gray, Proc. Am. Acad. 10:317. 1875, and in Brew. and Wats., Bot. Calif. 1:507. 1876; *P. californica* Cham., var. *imbricata* (Greene) Jepson, Fl. Middle Calif., 439. 1901; *P. imbricata* Greene, var. *condensata,* its subvar. *Hansenii,* var. *caudata* Brand. Univ. Cal. Publ. Bot. 4:220. 1912; *P. stimulans* Eastw., Proc. Cal. Acad. Sci., ser. 3, 2:291. 1902; *P. virgata* Greene, var. *ampliata* Greene, Erythea 4:55. 1896; *P. californica* Cham., var. *rubacea* Jeps., Man. Fl. Pls. Calif., 820. 1925; *P. corymbosa* Jeps., Man. Fl. Pls. Calif., 820. 1925.

Stems not over 4.5 mm. in diameter; racemes arranged in a loose spreading panicle, the inflorescence not at all virgate; calyx-lobes broadly lance-ovate to ovate, always more or less definitely imbricated.

Type locality: "Foothills to Yosemite," Mariposa Co., Calif. —Ranging from Humboldt Co. in northern California to Los Angeles Co. in southern California. Material examined: without locality, *E. Hall* (G); Klamath River, *Rattan in 1879* (G); Upper Clover Creek, *M. S. Baker in 1898* (P); Dunsmuir, Upper Sacramento R., *Jepson 6161,* type of *corymbosa* (Herb. Jepson); Table Mt., Butte Co., *Heller 10786* (G); Plains, Butte Co., *Mrs. Bruce 1978* (P); Mountain House, Colusa Co., *Ferris 6420* (P); Cache Creek, *Baker 2980* (G, P); Geysers, *Mann* (G); Santa Rosa Canyon, *M. S. Baker in 1898* (P); Marysville Buttes, *Ferris 6339* (P); Kelseyville, *Blankenship in 1924* (SA); Bartlett Springs, *Heller 12374* (G); Vacaville, *Heller & Brown 5408* (G, P); Napa Co., *Thurber in 1852* (G); Mt. St. Helena, *Baker 2601, 2604* (G, P), *Jepson in 1897* (G); Mill Valley, *Suksdorf 491* (G); Vallejo, *W. W. Jones 263* (G); Mt. Hamilton, *Elmer 2337, 4597* (P); Deer Ridge Farm, *Pendleton 367* (P); Los Gatos, *Heller 7415* (G); Stoney Creek, *Hansen 1283,* type coll. of subvar. *Hansenii* (P); Peoria Mt., *Mrs. Williamson 97* (P); Giant Forest, Tulare Co., *Howell 723* (SA); Yosemite National Park, *Eastwood 165* (G), Foothills to Yosemite, *A. Gray in 1872,* type (G); So. Fork Kaweah, *Culbertson 4200* (G, P); Lompoc, *Munz 11448* (P); San Luis Obispo, *Jones in 1882* (P); Zaca Lake Forest Reserve, *Eastwood 510* (G); Cholame, *Lemmon 4609* (G); Mt. Piños, *Munz 7046* (P); Seymour Creek, *Munz 7053* (P); Santa Paula, *Cobb 141* (P); Big Rock Creek, *Munz 6775* (P); Mt. Wilson, *Abrams 2591* (G, P).

This variety and var. *bernardina* are the only ones in the

group having ovate or lance-ovate sepals. Var. *calycosa* is readily separated from *bernardina*, however, by the smaller and shorter stems and especially by the imbricated calyx-lobes.

In his original description of 1875, Dr. Gray cited no specimens, but in the Bot. Calif. 1:507. 1876, he mentioned four: a cultivated specimen raised by E. Hall, one from Borax Lake collected by Torrey, one from foothills in Mariposa Co., collected by himself, and a Kellogg collection from Mission Hills, San Francisco. The Kellogg specimen is to be referred to *P. pinnata* var. *typica*. Of the other three I have not seen the Torrey collection, but the Hall and Gray ones agree in all essential characters. In order to typify *calycosa* more definitely, I suggest that Gray's own collection be designated as the type.

2c. PHACELIA CALIFORNICA Cham., var. BERNARDINA (Greene) Jeps., Man. Fl. Pls. Calif., 820. 1925. *P. virgata* Greene, var. *bernardina* Greene, Erythea 4:55. 1896; *P. californica* Cham., f. *bernardina* (Greene) Brand, Univ. Cal. Publ. Bot. 4:218. 1912.

Stems stout, 2.5 to 6 mm. in diameter, usually solitary from base, rarely several; calyx-lobes broadly lanceolate to lance-ovate, not at all imbricated.

Type locality: "along the base of the mountains near San Bernardino at 1200-1500 ft.", acc. to S. B. Parish (Zoe 5:11. 1900)—Range: Southern California from Santa Barbara Co. to San Diego Co., and southward into Lower California. Material examined: Santa Barbara, *Munz 10325* (P); Sulphur Mt. Spring, *Abrams & McGregor 50* (G); Pasadena, *Diana Haynes* (P); Liebre Mts., *Dudley & Lamb 4380* (P); Pine Flats, San Gabriel Mts., *Crow in 1930* (P); Brown's Flats, *Johnston 1443* (G, P); Swartout Valley, *Munz 4652* (P); Claremont, *Crawford in 1915* (P); *Munz 2256* (P), *Illingworth in 1898* (P), *Clency in 1916* (P); Upland, *Johnston 1944* (P); San Bernardino, *Parish 4150* (G), *Parish 11228* (P); Fredalba, *Abrams 2795* (P); Rancho Santa Ana, *Howell 965* (SA); *Johnston 2233* (SA); Strawberry Valley, Mt. San Jacinto, *Howell 559* (SA); Campo, *Wolf 2151* (SA); Julian, *Abrams 3794* (G, P); Cuyamaca Mts., *Palmer 246* (G); Laguna Mts., *T. S. Brandegee in 1904* (P); Pine Hills, *Mary F. Spencer 473* (G, P); Palomar Mts., *Munz 8214* (G, P); Palm Valley, Lower California, *Orcutt in 1883* (G).

2d. PHACELIA CALIFORNICA Cham., var. VIRGATA (Greene) Jeps., Man. Fl. Pls. Calif., 820. 1925. *P. virgata* Greene, Erythea 4:54. 1896; *P. magellanica* (Lam.) Cov., f. *virgata* (Greene) Brand, Univ. Cal. Publ. Bot. 4:219. 1912, in part; *P. californica* Cham., f. *vinctens* Macbride, Cont. Gray Herb., n. s. 49:37. 1917; *P. monosperma* Nels., Proc. Biol. Soc. Wash. 17:95. 1904.

Stems erect, solitary from base; leaves narrow, not exceeding

18 mm. wide, lanceolate to linear-oblong; inflorescence virgate; calyx-lobes narrowly linear-lanceolate to linear.

Type locality: Yreka, Calif.—Ranging from interior central California to western southern Oregon, and into adjacent Nevada. Material examined: NEVADA: Reno, *Jones in 1897* (P); Carson City, *Jones in 1897* (P); Petersons Ranch, *Hillman in 1894* (P); Verdi, *Heller 10604* (G). CALIFORNIA: Donner Lake, *Heller 6883,* type of f. *vinctens Macbride* (G), *Heller 14455* (SA); No. Fork Stanislaus River, *Stanford 658* (P); Snow Mt. Lake Co., *Heller 13228* (G); Mt. Sanhedrin, *Heller 5887* (P); Chat, *Jones in 1897* (P); Little Chico, *Mrs. Bruce 1978* (P); Chico Meadows, *Heller 11600* (G); Yreka Creek, *Butler 1386* (P); Yreka, *Greene 832,* type coll. of *P. virgata* Greene (G), *Butler 1280, 1300* (P); Sisson, *Heller 12422* (G); McCloud, *Eastwood 1064* (G); Little Grizzly Creek, *Heller & Kennedy 8852* (G); U. S. Forest Reserve, Plumas Co., *Eastwood 14434* (P). OREGON: Odell Lake, *Furlong, Wilson, Greeley,* and *Alexander in 1901* (P).

This variety grades into *P. heterophylla* in the pubescence of the calyx as shown in the following collections: Twin Lakes, Sequoia National Park, Calif., *Howell 713* (SA); between Mud Flat and Bennett Spring, Calif., *Heller 11550* (G); North Dome, Yosemite, *Keck 161* (P); Lily Lake, Tahoe, *Smiley 323* (G); Takilma, Josephine Co., Oregon, *Thompson 4659* (G); Deschutes River, Oregon, *J. C. Nelson 500* (G). It is distinguished by the character of dull white pubescence on the calyx, whereas the *heterophylla* group has glistening, yellowish, calyx-pubescence.

2e. *Phacelia californica* Cham., var. *jacintensis,* n. var.

Stems slender, not exceeding 2.5 mm. in diameter, two to several from base, ascending; leaves densely white-hirsute; calyx-lobes linear-lanceolate, blue or purplish; corolla blue or bluish white. (Caules tenues, 1.5-2.5 mm. crassi, non singuli; foliis denso albo-hirsutis; lobis calycis linearo-lanceolatis, subazureis; corollis hyacinthinis.)

Type: Tahquitz Valley, San Jacinto Mts., Calif., *E. C. Jaeger 1045,* July 1, 1922, Pomona College Herb. No. 13629. Other specimens seen: San Jacinto Mts., between Deep Creek and Gregg's Ranch, *Jaeger in 1921* (P); Tamarack Valley, *Munz 6402* (P).

2f. PHACELIA CALIFORNICA Cham., var. PATULA (Brand) Jepson, Man. Fl. Pls. Calif., 820. 1925. *P. magellanica* (Lam.) Cov., f. *patula* Brand, Univ. Cal. Publ. Bot. 4:219. 1912, as to type; *P. magellanica* (Lam.) Cov., f. *Ballii* Brand, Macbride, Cont. Gray Herb., n. s. 49:36. 1917.

Stems one to several from basal tuft of leaves, slender, not exceeding 3 mm. in diameter; leaves mostly narrow, 3 to 10 mm. wide, oblanceolate to elliptic-lanceolate, acute; cauline leaves re-

mote, but not much reduced; inflorescence slightly spreading, not virgate; calyx-lobes linear to narrowly linear-lanceolate.

Type locality: "Stonewall mine, 4600 ft. alt., in the Cuyamaca Mts., 4423 Parish." — Ranging in Southern California; at altitudes of 4500 to 7500 ft. Material examined: Mt. Piños, Ventura Co., *Grinnell in 1904* (P); Topatopa Mts., *Abrams & McGregor 77* (G); Prairie Fork, San Gabriel River, *Johnston 2092* (G, P); South Fork Lytle Creek, *Johnston 1451* (G, P); Pah-Ute Peak, *Purpus 5548* (G); Big Bear Valley, San Bernardino Mts., *Munz 5714* (P), *Harwood 4360* (P), *Howell 352* (SA), *Edwards in 1917* (P); San Jacinto Mt., *Mary F. Spencer 1237* (G, P); Fern Valley, San Jacinto Mts., *Munz 6060* (P); Santa Rosa Mts., *Munz 5923* (P); Stonewall Mine, Cuyamaca Mts., *Parish 4423,* type coll. (G).

It should be noted that in his publication of f. *patula* Brand cited much Sierran material, which is not here included under *patula.* But he stated that the "specimen originarium" was *Parish 4423,* which was collected in San Diego Co.

✓ 2g. Phacelia californica Cham., var. *egena* (Greene), n. comb. *P. egena* Greene, ex Brand, Univ. Cal. Publ. Bot. 4:218. 1912; *P. californica* Cham., f. *egena* (Greene) Macbride, Cont. Gray Herb., n. s. 49:37. 1917; *P. magellanica* (Lam.) Cov., f, *egena* (Greene) Brand, l. c.

Stems erect, rather slender, rarely exceeding 3 mm. in diameter; basal leaves lanceolate to ovate, 8 to 20 mm. wide, cauline leaves few and much reduced; racemes arranged in loose panicles, the inflorescence not at all virgate; lobes of the calyx linear to linear-lanceolate.

Type locality: So. Fork Kaweah River, California.—Ranging from Tulare Co. north to Oregon. Material examined: CALIFORNIA: Kern River Canyon, *Abrams 12017* (P); So. Fork Kaweah River, *Culbertson 4415,* Baker distribution, type coll. of *P. egena* Greene (G, P); Mariposa, *Congdon 36* (G); Yosemite Valley, *Abrams 4428* (G, P); Tahoe City, *Eastwood 447* (G); Sunnyside, Tahoe Region, *Eastwood 48* (G); Alder Springs, Glenn Co., *Heller 12796* (G); Marysville Buttes, *Heller & Brown 5565* (G); Oroville, *Heller 11257* (G); Red Clover Valley, Plumas Co., *Heller & Kennedy 8755* (G); Yreka, *Heller 7993* (G), *Butler 1356* (P); Morgan's Springs, *Eastwood 1753* (G). OREGON: Crater Lake, *Abrams 9771* (P).

3. Phacelia leucophylla Torr., in Fremont, Report, 93. 1845.

Perennial, sometimes biennial herbs; plants 1.5 to 5 dm. tall, sericeous with a closely-appressed, usually grayish white pubescence, also often somewhat hirsute; stems erect, sometimes ascending, one to several from base, usually leafy; leaf-blades elliptic to broadly oblong-lanceolate or oblanceolate, 2 to 8 cm. long,

0.5 to 2 cm. wide, mostly acute, entire (except in var. *compacta*); basal leaves densely rosulate, mostly long-petioled; cauline leaves few to several, not much reduced, the petioles shorter; inflorescence compact in anthesis becoming lax in fruit, racemes compact; calyx-lobes elliptic to oblong or linear, densely white-hispid and usually also finely canescent; corolla 4 to 8 mm. long, usually lilac; style long, twice length of the corolla, cleft to the middle; stamens long-exserted, filaments villous.

Key to Varieties

Calyx-lobes unusually setose-hispid. Vicinity of Bingen, Washington ..... 3b. var. *Suksdorfii.*

Calyx-lobes not unusually setose-hispid.

Leaves all entire.

Plants 1.5 to 5 dm. tall, appressed-sericeous ..... 3a. var. *typica.*

Plants much reduced, 10 to 25 cm. high, not at all canescent or sericeous. Montana through Wyoming and northeastern Utah ..... 3c. var. *alpina.*

Basal leaves pinnatified. Western Nevada and adjacent California ..... 3d. var. *compacta.*

3a. Phacelia leucophylla Torr., var. *typica,* n. nom. *P. leucophylla* Torr., in Fremont, Report, 93. 1845; *P. magellanica* (Lam.) Cov., f. *leucophylla* (Torr.) Brand, Pflanzenreich IV. 251:98. 1913; f. *angustifolia* Brand, l. c.; *P. canescens* Nutt., Journ. Acad. Philad., n. s. 1:159. 1848; *P. leptosepala* Rydb., Bull. Torr. Club 36:676. 1909; *P. Burkei* Rydb., l. c. 675; *P. heterophylla* Pursh, var. *pygmaea* Jeps., Man. Fl. Pls. Calif., 819. 1925.

Plants 1.5 to 5 dm. tall, sericeous; leaf blades entire (rarely pinnatifid); calyx-lobes elliptic or oblong to linear, densely white-hispid, also finely strigose-canescent.

Type locality: "Goat Island, upper north fork of the Platte." Ranging from Alberta to Colorado and to Inyo Co., California, thence north to British Columbia. Material examined: "Rocky Mts. & Blue Mts." *Nuttall,* type coll. of *P. canescens* (G); Rocky Mt. Flora, *Hall* & *Harbour 439* (G). ALBERTA: Crow Nest Pass, *Macoun 23777* (G). MONTANA: Wilsall, *Suksdorf 240* (G); Spanish Basin, *Rydberg* & *Bessey 4852, 4853* (G); Avalanche Lake, Glacier Park, *Jones in 1910* (P); Bozeman, *Hodgman in 1907* (G); Boulder Creek, *Scribner 167* (G); Bigfork, *Jones in 1908* (P); Alta, *Jones in 1909* (P); Sedan, *B. J. Jones in 1901* (G); Deer Lodge Valley, *Jones in 1905* (P); Lima, *Jones in 1908* (P); Anaconda, *Blankinship in 1906* (P). IDAHO: Bonanza, *Macbride* & *Payson 3395* (G, P); Wiessner's Peak, *Leiberg 1357* (G, P); Martin, *Macbride* & *Payson 3035* (G, P); Bear Creek below Parker Mt., *Macbride* & *Payson 3294* (G, P); Boise—Payette Project, *Macbride 877* (G, P); King Hill, *Nelson* & *Macbride 1084* (G, P); Trinity, *Macbride 561* (G); St. Anthony, *Merrill* & *Wilcox 826* (G),

Quayle 72 (P); Idaho Falls, *Merrill & Wilcox 826* (G); New Plymouth, *Macbride 186* (G); Salmon, *Payson 1847* (G); Henry's Lake, *A. & E. Nelson 6801* (G); Smoky Mts., *Macbride & Payson 3769* (G); Challis, *Macbride & Payson 3347* (G, P); Weiser, *Jones in 1899* (P); Tamarack, *Clark 184* (G); Valley of Spokane River, *Sandberg 655* (P); Paradise Hills, *Abrams in 1900* (P); Boise, *Macbride 256* (G); Silver City, *Macbride 428* (G). WYOMING: Seventeen Mile Well, *Goodding 226* (G, P); Afton, *Payson & Armstrong 3373* (G, P); Gros Ventre Range, *A. Nelson 1082* (G); Middle Fork of Powder River, *Goodding 313* (G, P); Mammoth Hot Springs, *A. & E. Nelson 5600;* Teton Pass, *Merrill & Wilcox 985* (G); Garfield Peak, *E. Nelson 5013* (G); Hawk's Ranch, *Churchill in 1918* (G); Leigh's Lake, *Merrill & Wilcox 1048* (G). COLORADO: Golden, *Jones in 1878* (P); Horsetooth Mt., *Cowen 1609* (G); Mt. Princeton, *Biltmore Herb. 3113* (G); Bridges Pass, *Englemann* (G); Cottonwood Gulch, *Sheldon 521* (G). UTAH: Thistle, *Jones 5536* (P); Peterson, *Pammel & Blackwood 3891* (G); Kimballs, *Mrs. Clemens in 1908* (G); Granddaddy Lake, *Mrs. Clemens in 1911* (P); Plymouth, *W. W. Jones 467* (G). NEVADA: Charleston Mts., *Purpus 6110* (P); Blaine P. O., Elko Co., *Heller 11110* (G); Muncy, *Jones in 1891* (P); Reno, *F. H. Hillman* (P); Mt. Rose, *Heller 10216* (G). CALIFORNIA: Waucoba Canyon, *Coville & Funston 1798* (G); Virginia Lakes, *R. Hoffmann in 1930* (P); Portola, *Payson 905* (G); Meeks Bay, Lake Tahoe, *Heller 13330* (G); Toad Lake, *Alexander & Kellogg 309* (P); Gazelle, *Heller 8080;* Mt. Shasta, *Copeland 3920* (P); Marble Mt., *Chandler 1655* (G); Plumas Co., *Mrs. Ames in 1873* (G); Goose Lake Valley, *Mrs. Austin 547* (P); Yreka, *L. E. Smith in 1915* (G); Adams, *Eastwood 2256* (G); Summit above Lake Valley, *K. Brandegee in 1908* (P). OREGON: Forked Horn Butte, *Whited Coll. 64* (G); Swan Lake Valley, *Applegate 366* (G); Drews Valley, *Mrs. Austin 1523* (P); Hood River Co., *Henderson 767* (G); Mt. Hood, *Jones in 1897* (P); Crescent, *Peck 2595* (G); Steins Mts., *Leiberg 2532* (G); Clear Water, *Spalding* (G). WASHINGTON: Spokane, *Kreager 116* (G); Swank River, Kittitas Co., *Sharples 188, 189, 190* (G); Bretton Springs, *Leiberg 383* (G, P); Calispell Valley, *Kreager 445* (G); Angel's Pass, *Thompson 7049* (G); Sprague, *Sandberg & Leiberg 171* (G); Entiat, Chelan Co., *Thompson 6358* (G). BRITISH COLUMBIA: Lardo, *Shaw 695* (G); Palliser to Glenogle, *Brown 776* (G).

This variety intergrades with *P. heterophylla* in the division of the leaves, such intergradation being shown in the following collections: Trail Glen, Colo., *Clements 54* (G); Boise, Idaho, *Clark 45* (G, P); Rockland, Wash., *Suksdorf 5045* (G); Rattlesnake Mts., Wash., *Cotton 475* (G). The type of *P. heterophylla* Pursh var. *pygmaea* Jeps. was not available for this study and the assignment of this variety to synonymy is entirely upon the basis of the description.

3b. PHACELIA LEUCOPHYLLA Torr. var. SUKSDORFII Macbride, Cont. Gray Herb., n. s. 49:34. 1917.

Calyx-lobes narrowly elliptic to sublinear, unusually setose-hispid on the margins and sometimes on the midrib, otherwise subglabrous.

Type locality: Bingen, Klickitat Co., Washington. Material examined: WASHINGTON: Bingen, *Suksdorf 3647,* type (G); Grand Dalles, *Keck 336* (P). OREGON: Arlington, *Mell in 1903* (G), *Thompson 4770* (G); Dalles, *Jones in 1897* (P).

This variety seems to be rather closely confined to the hot, dry region near Bingen, Washington and Arlington, Oregon.

3c. PHACELIA LEUCOPHYLLA Torr. var. ALPINA (Rydb.), n. comb. *P. alpina* Rydb., Mem. N. Y. Bot. Gard. 1:324. 1900; *P. leucophylla* Torr., f. *alpina* (Rydb.) Macbride, Cont. Gray Herb., n. s. 49:34. 1917; *P. heterophylla* Pursh, var. *alpina* (Rydb.) A. Nels. in Coulter & Nels. New Man. Rocky Mt. Bot., 408. 1909; *P. magellanica* (Lam.) Cov., f. *alpina* (Rydb.) Brand, Univ. Cal. Publ. Bot. 4:217. 1912; *P. nervosa* Rydb., Bull. Torr. Club *36*:675. 1909.

Plant grayish-strigose and hirsute; stems several from the base, erect or ascending, 10 to 25 cm. high; leaves grayish-strigose, not at all canescent or sericeous, oblong-lanceolate to oblanceolate, entire.

Type locality: Cedar Mountain, Montana.—Ranging through Wyoming and into northeastern Utah. Material examined: MONTANA: Cedar Mt., *Rydberg & Bessey 4855,* type of *alpina* (NY). WYOMING: Wyoming Range, west of Merna, *Payson 2772* (G, P); Gros. Ventre Mts., northeast of Bondurant, *Payson 3047* (P); hills east of Afton, *Payson & Armstrong 3241* (G, P); Jackson's Hole, *Payson 2286* (G). UTAH: Alta, *Jones 1137* (P); Juab, *Goodding 1065* (P); Deadman Mt., Summitt Co., *Greenman 4703* (G); Bear River, Summitt Co., *Goodman 1859* (G); Stillwater Fork, *Payson 5149* (G); Bingham, *Jones 1407* (P). COLORADO: Silver Plume, *Rydberg in 1895* (NY).

This variety is distinguished by the lack of the sericeous canescence characteristic of var. *typica.* The leaves usually have a green color as compared to the whitish appearance of those of var. *typica.* As here recognized, *alpina* is much less inclusive than in Macbride's treatment.

3d. PHACELIA LEUCOPHYLLA Torr., var. COMPACTA (Greene) Macbride, Cont. Gray Herb., n. s. 49:34. 1917. *P. compacta* Greene, Baker, W. Amer. Plants 18, no. 1142. 1902, as nom nudum; *P. magellanica* (Lam.) Cov., f. *compacta* (Greene) Brand, Univ. Cal. Publ. Bot. 4:217. 1912; *P. heterophylla* Pursh, var. *compacta* Jeps., Man. Fl. Pls. Calif., 819. 1925.

Plants caespitose, sericeous, 4 to 20 cm. tall; basal leaves long-petioled, pinnatifid; upper leaves often auriculate; calyx-lobes sparsely white-hispid, as well as canescent-strigose.

Type locality: Spooner, Douglass Co., Nevada. Ranging through western Nevada and adjacent California. Material examined: NEVADA: Spooner, *Baker 1142,* type collection (G, P); Virginia City, *Jones in 1881* (P); Charleston Mts., *Heller 1101* (G), *E. C. Jaeger* (P). CALIFORNIA: Yosemite slopes, *J. W. Congdon in 1897* (G).

In its habit this plant suggests *P. heterophylla* f. *frigida,* but is distinguished by the sericeous grayish-white canescence of its foliage and by the white hairs on the calyx, both features being distinctive of *P. leucophylla.*

4. PHACELIA DASYPHYLLA Greene ex Macbride, Cont. Gray Herb., n. s. 49:35. 1917. *P. dasyphylla* Greene ex Brand, Pflanzenreich IV. 251:97. 1913, in syn.; *P. heterophylla* Pursh var. *dasyphylla* Jeps., Man. Fl. Pls. Calif., 819. 1925.

Plants perennial, 10 to 20 cm. high; stems one to several from base, erect or ascending; leaves mostly basal, densely rosulate, oblanceolate, 1 to 4 cm. long, densely white-hirsute; inflorescence small, usually consisting of one to four racemes; calyx-lobes linear-lanceolate, white-hispid; stamens long-exserted, filaments glabrous.

Type locality: "Mt. Whitney, Cal."—Ranging from Mt. Whitney to Lake Tahoe. Material examined: CALIFORNIA: Mt. Whitney, *Culbertson 4355,* Baker distribution, type collection (G, P), *Mrs. Clemens in 1910* (P); Dick's Peak, Tahoe, *Smiley 428* (G).

This species seems to be quite definitely distinct from the South American *P. magellanica* which also has glabrous filaments. I have seen several collections of this South American species; in these whenever the plant tends toward the habit of *P. dasyphylla,* the flowers are much reduced and the filaments not at all exserted. The South American species is quite characteristic of the North American species.

5. PHACELIA PINNATA (R. & P.) Macbride, Cont. Gray Herb., n. s. 49:37. 1917.

Plants biennial or perennial, 3 to 8 dm. high; stems one to several from base, erect or slightly ascending, appressed-hispidulous to spreading-hispid; leaves mostly cauline, scattered along the stem, very rarely occurring in a basal cluster, entire or with one to several pairs of lateral basal leaflets, appressed-hispidulous to spreading-hispid, broadly lanceolate to elliptic or ovate, 3 to 10 cm. long; racemes tightly compressed, spreading in anthesis, hence inflorescence not truly virgate; calyx-lobes linear-

lanceolate to elliptic-lanceolate or narrowly elliptic, densely yellowish or white-hispid, this pubescence dull or glistening; corolla white or bluish, exceeding the calyx; stamens long-exserted, twice the length of the corolla, usually villous; style long-exserted, bifid.

KEY TO VARIETIES

Filaments entirely glabrous ..... 5c. var. *robusta*
Filaments pubescent, not glabrous.

Stems and leaves long-hispid; plant usually having a brownish or brownish-green appearance ..... 5a. var. *typica*

Stems sparsely short-hispid; leaves appressed hispidulous, having a greenish aspect ..... 5b. var. *pseudo-hispida*

5a. *Phacelia pinnata* (R. & P.) Macbride, var. *typica*, n. nom. *P. pinnata* (R. & P.) Macbride, Cont. Gray Herb., n. s. 49:37. 1917; *Aldea pinnata* Ruiz and Pavon, Fl. Peruv. II, 8:114. 1799; *P. circinnata* (Willd.) Jacq. f. Eclog. 1:135. 1816; *P. magellanica* (Lam.) Cov., f. *pinnata* Brand, Pflanzenreich IV. 251:99. 1913; f. *vulgaris* Walpers ex Brand, l.c; *P. nemoralis* Greene, Pitt. 1:141. 1887; *P. Biolettii* Greene, Pitt. 5:23. 1902.

Stems sparsely to densely white-hispid, the hairs stiff and spreading; leaves mostly large, 5 (rarely 3 or 4) to 10 cm. long, spreading white-hispid, usually having a brownish or brownish-green appearance; stamens pubescent.

Type locality: "Habitat in arenosis Conceptionis Chile et in Peruvia ad Cheuchin Provinciae Caxatambo vicum." Ranging north into Mexico, Arizona, and New Mexico; also in California from Santa Clara Co. northward into Oregon. Material examined: OREGON: Salem, *J. C. Nelson 2475* (G); Netarts Bay, *Peck 5570* (G); Jefferson City, *Abrams 8794* (P); Rogue River near Gold Beach, *Peck 8693* (G). CALIFORNIA: Oakland, *Jones 2359* (P), *Bolander in 1865* (G); Berkeley, *Miss Walker 1995, 153* (P); Mission Hills, *Kellogg* (G); Mt. Tamalpais, *Congdon in 1897* (G); Crystal Springs Lake, *Elmer 4419* (P); Bear Gulch, Sta. Cruz Mts., *Abrams 1575* (P); Smith Creek, *Pendleton 796* (P), *Heller 8586* (G); Saratoga, *Pendleton in 1907* (P); Forest Grove, *Jepson in 1896* (G); Los Gatos, *Heller 7450* (G). ARIZONA: Chiricahua National Forest, *Eggleston 10812* (G). NEW MEXICO: White Mts., *Wooton 291* (P). MEXICO: Ixtaccihuatl, *Purpus 1766* (G, P); Chihuahua, *Palmer 389* (G); Tlalmanalco, *Seler 5333* (G). CHILE: Valparaiso, *Buchtien in 1895* (G); Quintero, *Werdermann 48* (G); Limache, *Garaventa 1426* (G); Ternos, *Deltor 2027* (G).

With the material available for this study I am unable to separate *Phacelia nemoralis* Greene described from California from *P. pinnata* (R. & P.) Macbride described from South America. These species were separated by Macbride (Cont. Gray Herb., n. s. 49:37. 1917) on the basis of division of leaves. However, I have been unable to distinguish in any way whatsoever, material referred by him to the two species and must reduce *P. nemoralis* to synonymy under *P. pinnata.* At most, the South American specimens seen tend to have smaller leaves and a more scattered, shorter pubescence than do plants from North America.

5b. *Phacelia pinnata* (R. & P.) Macbride, var. *pseudo-hispida* (Brand), n. comb. *P. mutabilis* Greene, Eryth. 4:55. 1896; *P. nemoralis* Greene, var. *mutabilis* (Greene) Macbride, Cont. Gray Herb., n. s. 49:37. 1917; *P. nemoralis* Greene, var. *pseudo-hispida* Brand, Univ. Cal. Publ. Bot. 4:219. 1912.

Stems mostly rather sparsely short-hispid, leaves smaller than in var. *typica,* 2 to 6 cm. long, appressed-hispidulous, the general aspect being more truly green than that of var. *typica.*

Type locality: "common towards Castle Peak," California. Ranging from western Washington to California and New Mexico. Material examined: WASHINGTON: Mt. Paddo, *Suksdorf 7377* (G); Mt. Rainier National Park, *Abrams 9213* (P); Montesana, *A. A.* & *E. Gertrude Heller 3923* (G); Centralia, *Palmer 37932* (G); Shoalwater Bay, *Cooper in 1854* (G). OREGON: Pamelia Lake, *J. C. Nelson 2792* (G); Takilma, *Peck 8185* (G); Crater Lake National Park, *Heller 12593* (G), *Jones 1522* (P); Oswego Lake, *J. C. Nelson 2757* (G). CALIFORNIA: Mt. Eddy, *Heller 12231* (G); Stalker's, Shasta Co., *M. S. Baker 344,* Univ. Calif. Herbarium, type of *P. nemoralis* Greene, var. *pseudo-hispida* Brand; McClouds, *L. E. Smith 504* (G); Scott Mts., *Greene 1032* (G); Summit, *Heller 9861, 6960* (G); Jonesville, *Copeland 446* (SA), *Heller 12869* (G); Butte Meadows, *Heller 12168* (G); Mariposa, *Congdon 9955* (G); Armstrong Station, *Hansen 1129* (G, P); Mather, Tuolumne Co., *Munz 7418* (P); Cahoon Meadow, Sequoia National Park, *Howell 718* (SA); Mammoth, Mono Co., *Coville & Funston 1824* (G). ARIZONA: Pinaleño Mts., *Munz 1242* (P); Spud Ranch, Rincon Mts., *Blumer 3357* (G); Barfoot Peak, *Blumer 1471* (G); Gulch at head of Pine Canyon, *Blumer 1474* (G). NEW MEXICO: Sawyer's Peak, Grant Co., *Metcalfe 1398* (G, P).

The important character to be used in distinguishing this variety from var. *typica* is the pubescence and general aspect of the leaves. In this variety the pubescence of the leaves is quite short and always appressed, and the leaves have a definitely greenish color, whereas in var. *typica* this pubescence is long and spreading and the leaves have a brownish cast.

5c. PHACELIA PINNATA (R. & P.) Macbride, var. ROBUSTA (Brand) Macbride, Cont. Gray Herb., n. s. 49:37. 1917. *P. magellanica* (Lam.) Cov., f. *robusta* Brand, Pflanzenreich IV. 251: 97. 1913; f. *amoena* Brand, l. c., in part.

Plant similar to var. *typica* in the vegetative aspects; stamens long-exserted, entirely glabrous.

Type locality: "Mexiko: Auf dem Gipfel des Berges San Felipe (Andrieux n. 211)" (This is the specimen first cited by Brand). Ranging from Mexico into western South America and Bolivia. Material examined: MEXICO: Cerro San Felipe, Oaxaca, *E. W. Nelson 1086* (G); Sierra Madre, Chihuahua, *E. W. Nelson 4811* (G). PERU: Matucana, *Macbride 2939* (G). BOLIVIA: Cochabamba, *Bang 1040* (G); La Paz, *Buchtien 364* (G), *Mandon 377* (G); Soratá, *Rusby 1157* (G).

This variety is separated from var. *typica* by its glabrous stamens.

DOUBTFUL SPECIES

Phacelia rudis Dougl. ex A. DC., Prod. 9:298. 1845.

This species is published in synonymy in de Candolle's Prodromus, and lacks a description or a reference except this legend, "herb, et hort. soc. hortic."

Pomona College,

Claremont, California.

A REVISIONAL STUDY OF THE PHACELIA HISPIDA GROUP

By John W. Voss

It has been my pleasure to study this particular group of Phacelias under the direction of Dr. Philip A. Munz of Pomona College. It was at his suggestion that I undertook the problem. I have had available for this study the material in the following herbaria, to the curators of which I am deeply indebted:

Gray Herbarium of Harvard University (G),
Herbarium of Pomona College (P).

and I have had also types and special material from:

University of California (C),
Herbarium of Prof. Jepson (Jeps.),
California Academy of Sciences (C. A.),
United States National Herbarium (U. S.).

The abbreviations above indicated are used in the citation of specimens.

Discussion of Criteria for the Differentiation of Entities.

Consistent characters by which these groups, for the most part, may be segregated are the appendages within the corolla. There are 10 of these and they occur in pairs at the base of each stamen, forming a V-shaped pocket for the filament. The size, shape, and proportion of these appendages vary. For convenience in describing these I have used the terms *lamella,* referring to the attached portion with its elongated termination (if present), and *transverse portion,* referring to the lower unattached lip which extends inward toward the center of the corolla. The appendage characters provide a useful means of distinguishing between *Ph. cryptantha* var. *typica* and var. *derivata;* the presence or absence of projecting tips at the upper ends of the lamellae giving a constant basis for differentiation. There is variation in the length of the attached portion, and there are forms suggesting intergradation.

Corolla size is a convenient character in differentiating *Ph. cryptantha* and *Ph. umbrosa* from *Ph. hispida* and *Ph. vallismortae,* and also for distinguishing the varieties of *Ph. vallismortae.*

Seeds are important characters in several groups, particularly in *Ph. hispida* var. *heterosepala,* where the plant is morphologically

difficult to distinguish, and yet the seeds are very different from those of any of the other entities herein discussed, in regard to size, shape, and number. In *Ph. eximia* also the number and size of the seeds are the real determining factors.

The length of the stamens, whether included or exserted, is a characteristic usable in differentiating between *Ph. cryptantha* and *Ph. umbrosa,* and for distinguishing *Ph. vallis-mortae* var. *typica.*

The degree of hispidity is useful for distinguishing *Ph. hispida* var. *Hubbyi. Ph. umbrosa* is the least hispid of any of the group. *Ph. vallis-mortae* but slightly more so, and *Ph. cryptantha* and *Ph. hispida* var. *genuina* increasingly so in that order.

Density of inflorescence is a helpful diagnostic character for *Ph. hispida* var. *eximia,* in which the flowers are comparatively widely spaced (about 4 mm.), and in *Ph. hispida* var. *Hubbyi,* and *Ph. umbrosa* where the inflorescence is long and the flowers are packed closely together.

Distinctions of leaf shape and size may be made particularly in *Ph. umbrosa,* where the leaves are exceptionally thin and scarcely more than irregularly crenate, and in *Ph. hispida* var. *cicutaria* where leaves are pinnately divided, the margins of the pinnae being coarsely serrate.

Key to Species

Corolla small, less than 5 mm. wide.

Stamens equaling or exceeding corolla. Todos Santos, Lower Calif. .....3. *Ph. umbrosa.*

Stamens one-half or three-fourths as long as corolla. Colo. and Mohave deserts. .....2. *Ph. cryptantha.*

Corolla large, 8-16 mm. wide.

Appendages in corolla 1.5-2 mm. long, transverse portion inconspicuous, or absent. Death Valley area, and lower San Joaquin Valley. .....4. *Ph. vallis-mortae.*

Appendages less than 1.5 mm. long, or if as long, having transverse portion about equal in proportion to lamella. .....1. *Ph. hispida.*

1. Phacelia hispida Gray, Syn. Fl. 2:161. 1878, Suppl., 415. 1886.

Ph. ramosissima Doug. var. *hispida* Gray, Proc. Amer. Acad. 10:319. 1875.

Annual, 1.5-6 dm. high, usually erect; stems simple, branching from the base, or diffuse, setose-hispid with long and slender white bristles; leaves usually merely incised, sometimes parted and incised, occasionally with pinnae lobed or divided; spikes soon loose and loosely paniculate, 5-20 cm. long in fruit; flowers nearly all on short slender pedicels; calyx from one-half to one and one-

eighth times the length of corolla; lobes elongating greatly in fruit, narrowly linear or spatulate with attenuated base; corolla campanulate-spreading, 8-10 mm. wide, white to purple; stamens 1 to nearly 1.5 times the length of corolla, and each rising from a pair of appendages inserted just below the middle of the corolla tube; style equaling or barely exceeding corolla; seeds 2-4, favose-pitted, brown, 1.25-3 mm. long, 0.75-2 mm. wide.

Key to Varieties

Plant stout, grayish and shaggy hirsute throughout; racemes very dense especially in fruit. Ojai Valley to San Fernando..... .....1c. var. *Hubbyi.*

Plant greener below; fruiting racemes more or less open. Flowers separated, evenly spaced; stems weak; seeds 2 or 3. San Gabriel Mts. .....1b. var. *eximia*

Flowers close together.

Seeds 4, 3-sided.

Seeds 3 mm. long, 1.5 mm. wide. Interior Valley of Calif. to Ft. Tejon. .....1d. var. *cicutaria.*

Seeds not exceeding 1.5 mm. in length. Calif. from Paso Robles southward to Lower Calif. ....1a. var. *genuina.*

Seeds 2, oval, flattened, 3 mm. long, 2 mm. wide. Butte Co., Calif. .....1e. var. *heterosepala.*

✓ 1a. Ph. hispida var. genuina Brand, Univ. Calif. Pub. Bot. 4:214. 1912.

Appendages with transverse portion equaling lamella; lamella tipped with short points, or almost truncate; seeds less than 2 mm. long, less than 1 mm. wide.

Type locality, probably Santa Barbara, as that is the first place named in Gray's description. When Gray made his *Ph. ramosissima* var. *hispida* he cited no collectors; later in the Bot. Calif. 1:508. 1876, and in Syn. Fl. 2:161, 1878, he named Nuttall first among several collectors. I have not seen the Nuttall specimen and cannot be sure whether it came from Santa Barbara or not. Ranging in cismontane Calif. from Paso Robles southward. Specimens seen, CALIFORNIA: Cult. at Berkeley, *Davy 7395* (P); 16 mi. east of Santa Maria, *Munz 11431* (P); Dutard's Ranch, near boundary of Santa Barbara and San Luis Obispo Cos., *Eastwood, May 9, 1896* (G); *Eastwood, June 13, 1902* (G); Santa Barbara, *Elmer 3867* (P); Santa Inez Mts., *Cooper, June 1897* (G); San Marcos Road, Painted Cave Ranch, near Santa Barbara, *Eastwood, May, 1908* (G); Santa Barbara Co., *Torrey 351, 1865* (G); Ojai Valley, *Munz 11493* (P); Hobo Hot Springs, Kern Co., *Abrams 11961* (P); Bouquet Canyon, near Saugus, *Munz 6931* (P); San Fernando Mts., *Abrams 1350* (P); Sul-

phur Mountain Spring, Sulphur Mts., *Abrams* & *McGregor 51* (G); Santa Monica Mts., *Munz* & *Harwood 3958* (P); Catalina Is., *Pendleton 1364* (P); Laurel Canyon, near Los Angeles, *Eastwood 110* (G); "California", *Wallace* (G); Pasadena, *Grant 964* (G); San Jose Hills, south of San Dimas, *Munz & Harwood 3305* (P); Pomona, *Baker 4749* (P, G); Claremont, *Baker 4776* (P, G); Barret Canyon below Camp Baldy, *Reed 4913* (P); Lytle Creek Canyon, *Street, May 30, 1918* (P); San Bernardino, *Parish 3670* (G); San Bernardino Mts., *Parish 11315* (P), *Parish 4834* (P); Santiago Peak, Orange Co., *Abrams 1820* (P), *Munz 7097* (P); Santiago Creek Canyon, Orange Co., *Geis 512* (P); Laguna Beach, *Breckenridge, April 17, 1920* (P); Laguna Mts., *Munz 9732* (P); 2 mi. W. of Dripping Spring, *Munz 9837* (P); Palm Springs, *Spencer 2110* (G); near Fallbrook, *Munz* & *Harwood 3859* (P); San Diego, *Cleveland 1874* (G); Between Potrero and Campo, *Abrams 3717* (P); Pala Grade, *Hill, April 19, 1925* (P); Witch Creek, *Alderson, June 1894* (G); Mesa Grande, *Spencer 1133* (P, G); S. E. of Buckmans Spring, *Munz* (P); Chariot Canyon, San Felipe Creek, *Keck* & *McCully 109* (P); Foster, *Spencer 326* (G, P). LOWER CALIFORNIA: Northern Lower Calif., *Jones, April 7, 1882* (P), *Orcutt,* in *1883* (C); 15 miles north of Ensenada, *Canby, April 3, 1925* (P).

1b. *Ph. hispida* var. *eximia* (Eastw.) n. comb.

Ph. eximia Eastwood, Bull. Torr. Bot. Club 32:204. 1905.

Plant with weak stems; terminal leaflets compound trifoliate; inflorescence loose in young plant; corolla 8-10 mm. broad, stamens conspicuously exserted, anthers large; seeds, usually two, sometimes 3, large, 2 mm. long, 1.25 mm. wide.

Type locality, Mt. Wilson, Los Angeles Co., Calif. Range, San Gabriel Mts., Calif. Specimens seen, CALIFORNIA: Mt. Wilson, *Fordyce Grinnell, Jr.,* Dec. 31, 1903, type (C. A.); Crystal Lake, San Gabriel Mts., Los Angeles Co., *E. Crow,* June 29, 1930 (P).

This variety is admittedly very near to var. *genuina,* but seems to be a local entity distinguished by its larger and fewer seeds.

1c. Ph. hispida var. Hubbyi Macbride, Cont. Gray Herb., n. s., 49:29. 1917.

Plant unusually white hispid, stout; inflorescence dense, conspicuously so in fruit; corolla 6-7 mm. broad, pale; scales with broad lamellae, tapering gradually to a sharp point at the tip; stamens conspicuously exserted, half as long again as corolla; seeds 4, 3 mm. long.

Type locality, Sulphur Mt., Ventura Co., Calif. Range, San Fernando to Ojai Valley, Calif. Specimens seen, CALIFORNIA:

Sulphur Mt., *Hubby 36, May 20, 1896,* type (G), *Hubby 35, April 12, 1897* (G); *Hubby 34, April 12, 1897* (G); Mt. slopes, Ojai Valley, *Hubby 31, May 20, 1896* (G); Santa Clara River, Ventura Co., *Gray in 1885* (G); near San Fernando, L. A. Co., *Hitchcock 14* (P).

1d. PH. HISPIDA var. CICUTARIA (Greene) Macbride, Cont. Gray Herb., n. s., 49:29. 1917.

Ph. hispida var. *genuina* subvar. *cicutaria* Brand, Univ. Calif. Pub. Bot., 4:215. 1912. *Ph. cicutaria* Greene, Pittonia 5:20. 1902.

Plant 2-4 dm. high, erect; leaves pinnately divided, margins of pinnae coarsely serrate; corolla pale, appendages with transverse portion exceeding vertical portion in length, and tending to lie close to the filament; seeds 4, 3 mm. long, 1-1.5 mm. wide, 3-sided.

Type locality, Knight's Ferry, Stanislaus Co., Calif. Range, interior valley of California. Specimens seen, CALIFORNIA: Knight's Ferry, *F. W. Bancroft, April 9, 1885,* type (C); Caliente, *Heller 7611* (G); Raymond, *Cummings, May 22, 1896* (G); Lindsay, *Munz 9091* (P); Iron Canyon, *Bruce in 1892* (P); San Luis Obispo, *Jones, May 8, 1882* (P); Tehachapi, *Jones, May 20, 1903* (P, G); Oroville, *Heller 10709* (G); Emmet to Panoche Pass, San Benito Co., *Abrams* and *Borthwich 7894* (P); Colusa Co., *Ferris 6407* (P); Jacksonville, *Fosberg, April 9, 1927* (P); Blochman's Ranch, *Eastwood 4256* (G); Pollasky, *Heller 8146* (G); Fort Tejon, *Xanthus* 90 (G); *Fremont's Expedition 402, in 1842* (G); Three Rivers, Tulare Co., *Eastwood, May 15, 1894* (G); Zaca Lake, *Eastwood 539* (G).

1e. PH. HISPADA var. HETEROSEPALA (Greene) n. comb.

Ph. hispida var. *genuina* subvar. *heterosepala* Brand, Univ. Calif. Publ. Bot. 4:215. 1912. *Ph. heterosepala* Greene, Pittonia 5:21. 1902.

Leaves usually only incised; seeds large, usually 2, flattened-ovate, dark brown, 3 mm. long, 2 mm. wide.

Type locality, Iron Canyon, Butte Co., Calif. Range, Butte Co., Calif. Specimens seen, CALIFORNIA: Iron Canyon, above Chico, *Austin, May 1883,* type (C); Cold Canyon, Butte Co., *Austin, June 1879* (G).

This variety, based largely on seed characters, is admittedly a very local entity and does not occupy its area to the exclusion of var. *cicutaria* as can be seen by the specimens cited under that variety.

2. PHACELIA CRYPTANTHA Greene, Pittonia 5:21. 1902.

Plants resembling *Ph. hispida,* but differing in having corolla 3-5 mm. wide, scales with the transverse portion much reduced, and stamens included.

Key to Varieties

Sepals 1:5 mm. wide or less, appendages in corolla tipped with bristle-like point ..... 2a. var. *typica.*

Sepals 1.5-2 mm. wide, appendages semiovate with no bristle-like tip ..... 2b. var. *derivata.*

2a. Ph. cryptantha Greene var. *typica* n. nom.

Ph. cryptantha, Greene, Pittonia 5:21. 1902. *Ph. hispada* var. *brachyantha* Coville, Cont. U. S. Nat. Herb. 4:158. 1893. *Ph. eremica* Jepson, Manual of Flowering Plants of Calif., 823. 1925.

Plants erect, 1.5-4 dm. tall; stems branching, thin; corolla 3-4 mm. wide; stamens about half as long as corolla, appendages elongate, narrow, terminating in a sharp point, transverse portion inconspicuous; seeds 4, 1:5-2 mm. long.

Type locality, Surprise Canyon, Panamint Mts., Inyo Co., Calif. Range, Borders of Mohave and Colorado Deserts. Specimens seen, CALIFORNIA: Surprise Canyon, Panamint Mts., Inyo Co., *Fredrick Funson 607,* type (U. S.); Collins Valley, *Jepson 8852,* April 28, 1920, type of *eremica* (Jeps.); Big Rock Creek, San Gabriel Mts., *Munz 6817* (P, G); Cajon Pass, *Jones, May 16, 1903* (P); Deadman's Pt., Mohave Desert, *Johnston, May 16, 1920* (P); Old Woman Mts., *Jones, May 13, 1926* (P); Quail Springs, Mohave Desert, *Gilman A9* (P); Willow Springs, Kern Co., *Munz 10028* (P); Box Canyon, Colo. Desert, *Munz & Hitchcock 12,051* (P); Mohave, *Jones, May 20, 1903* (P). NEVADA: Meadow Valley Wash, mile 16, *Jones, April 28, 1904* (P). ARIZONA: Mineral Park, *Lemmon 3349* (G); Chimehuevis, *Jones, April 21, 1903* (P); Skull Valley, *Jones, May 1, 1903* (P); Hackberry, *Jones, April 25, 1903* (P); near Prescott, *Rusby, May 1885* (G).

Through the kindness of Prof. Jepson, I have had the privilege of examining his type of *eremica* and through that of Dr. W. R. Maxon I have likewise seen flowers from the type of Coville's *Ph. hispida* var. *brachyantha* which variety was renamed by Greene as *Ph. cryptantha.* In the key to Phacelia in Jepson's Manual, *P. eremica* is separated from *P. cryptantha* on the basis of having the corolla longer than the calyx, while it is given as shorter than the calyx in the latter species. From an examination of both types and the study of the scales I am convinced that the two are synonymous and that some of the material which has been referred to *cryptantha* (*hispida* var. *brachyantha*) differs in its scales and for it is proposed the following new variety:

2b. Ph. cryptantha var. derivata n. var.

Plant 1-3 dm. high with thin weak stems; inflorescence short, compact; sepals 5-7 mm. long, elongating rapidly in fruiting condition, equaling or slightly exceeding corolla; corolla pale laven-

der, 2-5 mm. wide; appendages semiovate, transverse portion barely evident; stamens included; seeds 4, 2.5 mm. long, 1.5 mm. wide. (Planta 1-3 dm. alta, cum. caulibus tenuibus debilibusque; inflorescentia breve, compacta; sepalis 5-7 mm. longis, post florationem rapide extendentibus; corolla lavendula, 2-5 mm. lata; appendiculis semiovatis, partibus transversis appendiculorum vix evidentibus; staminibus inclusis; seminibus 4, 2.5 mm. longis, 1-1.5 mm. latis.)

Type from Shepherds Canyon, Panamint Mts., Inyo Co., Calif. *M. E. Jones, April 30, 1897* (Pomona College Herbarium No. 73398). Range, northern and eastern edge of Mohave Desert. Specimens seen CALIFORNIA: East of Bishop, *Jones, May 14, 1927* (P); Lone Pine Creek, Alabama Hills, Inyo Co., *Hall & Chandler 7182,* May 26, 1906 (P). ARIZONA: Mt. Trumbull, *Palmer 334.5* (G). NEVADA: Eldorado Canyon, Nelson, *Jones, April 30, 1907* (P).

This variety intergrades with var. typica in the ratio of corolla to calyx length, and in the shape of the appendages. In the intergrades, the lamella of the appendage is not so elongate but the projecting tip is present at the top. The collection Eldorado Canyon, Nelson, Nev., *Jones, April 30, 1907* (P), is an intergrade most like *derivata,* while the collection of *Rusby,* near Prescott, Ariz., is more like *typica,* hence is mentioned under that variety.

3. Ph. umbrosa Greene, Erythea 2:191. 1894.

Ph. hispida var. *umbrosa* (Greene) Brand, Pflanzenreich IV, 251:88. 1913.

Annual, resembling *Ph. hispida* but sparingly hispid, not glandular; stems very slender, freely branching; leaves numerous, thin, only irregularly crenate; corolla small, 2-4 mm. wide, pale violet, stamens equaling corolla; appendages with wide lamellae, truncate or only slightly pointed at top; seeds 2-2.5 mm. long, 1 mm. wide.

Type locality, northern part of peninsula of Lower California. Specimens seen, LOWER CALIFORNIA: near Todos Santos Bay, *C. R. Orcutt, July 11, 1885* (G, C). The specimen at Univ. of Calif. is probably incorrectly labeled as coming from southwestern part of Colorado Desert, San Diego Co., Calif.

4. Phacelia vallis-mortae sp. nov.

Allied to *Ph. hispida,* the plant 2-5 dm. high, diffuse, branching several times from the base; stems weak, sparingly hispid, but covered with a denser glandular pubescence beneath; leaves few, pinnately divided, hispid, hairs enlarged at base; sepals two-thirds as long as corolla, narrowly oblanceolate, less than 1 mm. wide; corolla lavender, broadly funnel-form, 8-16 mm. long, 8-16

mm. broad; appendages long, lamellae 1.5-2 mm. long, truncate to slightly pointed at tips, transverse portion inconspicuous; stamens shorter than or barely equaling length of corolla; seeds 4, 3 mm. long, 1.5 mm. broad. (Planta 2-5 dm. alta, diffusa; caulibus debilibus, parce hispidis et dense breveque glanduloso-pubescentibus; foliis paucibus, pinnate divisis, hispidis, sepalis anguste oblanceolatis, vix 1 mm. latis, brevioribus quam corollis; corollis lavendulis, late infundibuliformibus, 8-16 mm. longis, 8-16 mm. latis; appendiculis longis; lamellis 1.5-2 mm. longis, truncatis aut parce acutis, partibus transversis appendiculorum inconspicuis; staminibus brevibus quam corollis aut vix equalibus aut exsertis; seminibus 4, 3 mm. longis, 1.5 mm. latis.

Type from sandy wash, Keane's Spring, Amargosa Range, Death Valley, Invo Co., Calif., *Munz 12580,* May 9, 1932. (Pomona College Herbarium No. 187405.)

Key to Varieties

Flowers 8-10 mm. wide, Death Valley region .... 4a. var. *typica.*
Flowers 14-16 mm. wide, Lower San Joaquin Valley..... ..... 4b. var. *heliophila.*

4a. Ph. vallis-mortae Voss var. typica n. nom.

Flowers 8-10 mm. wide; stamens not exserted.

Range, Death Valley area. Specimens seen, CALIFORNIA: Dantes Point, Death Valley, *Jaeger, May 2, 1927* (P); Panamint Mts., Inyo Co., *Jaeger May 2, 1927* (P); Tehachapi, *Jones, May 20, 1903* (P); Bishop, *Heller 8255* (G); S. W. of Shoshone, *Hitchcock 12343* (P); Bonanza King Mine, Mohave Desert, *Munz, Johnston, Harwood 4285* and *4023* (P); Bradbury Well, Mohave Desert, *Munz & Hitchcock 11009* (P); 7 mi. east of Daggett, *Munz & Keck 7837* (P); south of Barstow, *Munz 2576* (P); 8 mi. east of Victorville, *Jaeger, April 4, 1932* (P). NEVADA: Columbus Marsh, *Jones, June 17, 1927;* Meadow Valley Wash, mile 16, *Jones, April 28, 1904* (P); Potosi Mt., Clark Co., *Jaeger, May 28, 1930* (P). UTAH: Diamond Valley, *Goodding 823* (G).

4b. Ph. vallis-mortae var. heliophila (Macbride) n. comb.

Ph. hispida var. *heliophila* Macbride, Cont. Gray Herb., n. s., 49:29. 1917.

Freely branching; corolla showy, 12-16 mm. broad, pale purple with darker veins; appendages with lamellae 2 mm. long, tapering upward and ending in a long narrow, unattached point; stamens exserted; seeds 4, 3 mm. long.

Type locality, Sunset, Kern Co., Calif. Range, Southern part of San Joaquin Valley. Specimens seen, CALIFORNIA: Sunset, *Heller 7730,* April 20, 1905, type (G); north of Lebec, Kern Co., *Jones, April 24, 1927* (P).

Pomona College, Claremont, Calif.

EXPLANATION OF PLATE 56

Figures 1 to 6 show the character of the appendages within the corolla tube at the base of each stamen. The drawings were made with the aid of camera lucida. Figure 7 shows the general distribution of the entities.

Fig. 1. *Phacelia hispida* var. *genuina,* from *Parish 11315* (P).

Fig. 2. *Phacelia vallis-mortae* var. *heliophila,* from type (G).

Fig. 3. *Phacelia cryptantha* var. *typica,* from *Munz 6817* (P).

Fig. 4. *Phacelia hispida* var. *cicutaria,* from type (C).

Fig. 5. *Phacelia vallis-mortae* var. *typica,* from type (P).

Fig. 6. *Phacelia cryptantha* var. *derivata,* from type (P).

Fig. 7. 1a = *Ph. hispida* var. *genuina.*
1b = *Ph. hispida* var. *eximia.*
1c = *Ph. hispida* var. *Hubbyi.*
1d = *Ph. hispida* var. *cicutaria.*
1e = *Ph. hispida* var. *heterosepala.*
2a = *Ph. cryptantha* var. *typica.*
2b = *Ph. cryptantha* var. *derivata.*
3 = *Ph. umbrosa.*
4a = *Ph. vallis-mortae* var. *typica.*
4b = *Ph. vallis-mortae* var. *heliophila.*

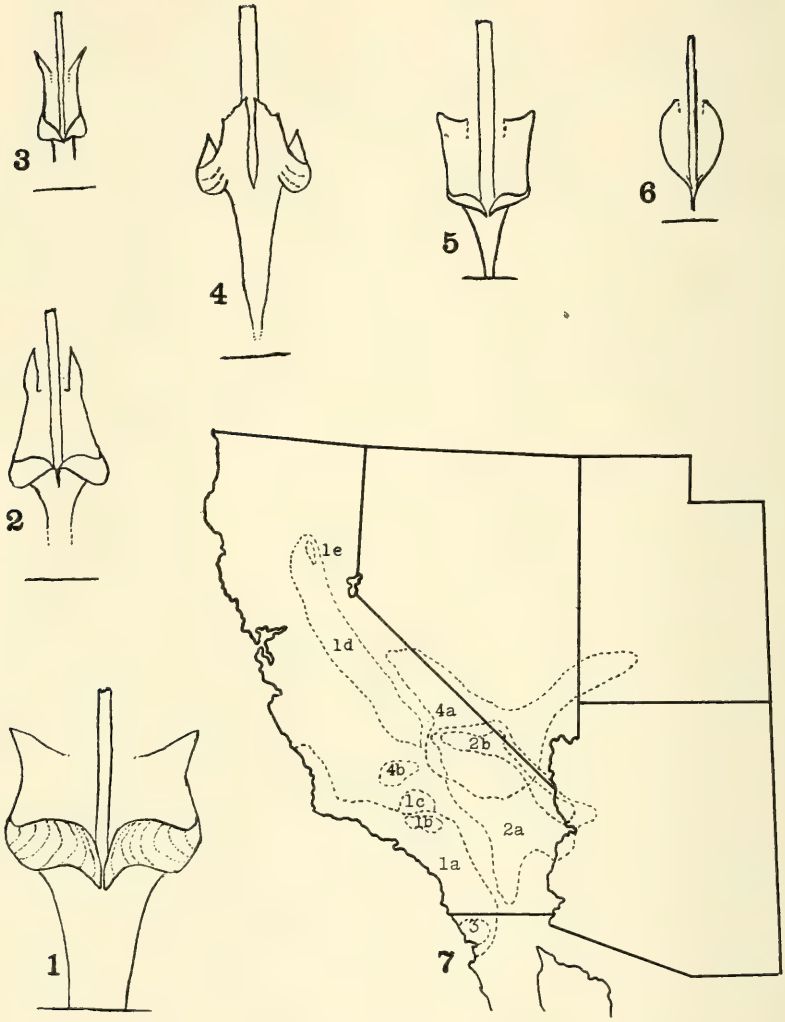

PLATE 56

BULLETIN of the SOUTHERN CALIFORNIA ACADEMY of SCIENCES

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Southern California Academy of Sciences

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■ ■

Bulletin of the
Southern California Academy of Sciences

Began issue with Vol. I, No. 1, January, 1902. Issued ten numbers in 1902, nine numbers in 1903, 1904, 1905; three numbers in 1906. Issued two numbers annually from 1907 to 1919, both inclusive (except 1908—one issue only). Issued four numbers (January, May, July and October) in 1920.

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The 1922 issues are: Vol. XXI, No. 1, March; Vol. XXI, No. 2, September.

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"	28,	"	1.	January,	1929	.25
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"	29,	"	2.	May,	1930	.25
"	29,	"	3.	September,	1930	.25
"	30,	"	1.	January,	1931	.25
"	30,	"	2.	May,	1931	.25
"	30,	"	3.	September,	1931	.25
"	31,	"	1.	January,	1932	.25
"	31,	"	2.	May,	1932	.25
"	31,	"	3.	September,	1932	.25
"	32,	"	1.	January,	1933	.25
"	32,	"	2.	May,	1933	.25
"	32.	"	3.	September,	1933.	.25
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Bulletin, Southern California Academy of Sciences

VOL. XXXIII, 1934

INDEX OF SUBJECTS

New species and varieties indicated in bold face type.

INDEX OF AUTHORS

CORRECTIONS TO VOL. XXXIII

Page 105, line 29: "purii—" should be "puri—".

Page 106, line 19, should read:
"side Co., Calif., Parish 8306 (D). I have seen the specimen and"

Page 152, paragraph 1, line 9: Spell "Willamette".

Page 153, lines 3-6 from bottom of page should be indented 2 ems.

Page 154, line 23: Italicize "Leonard in 1885", "Payson 1770". Last line: Italicize "Goodding 547".

Page 156, line 21: Spell "Willamette". Line 10 from bottom: Spell "appresso-hirsutis".

Page 157: Reorganize Key to Varieties:

Calyx-lobes elliptic-lanceolate to ovate.
- Calyx-lobes imbricated, broadly lanceolate to ovate, corolla white to yellowish ..... 2b. var. *calycosa*
- Calyx-lobes not imbricated, somewhat narrower.
  - Corolla blue; dried plants brownish-green in appearance. San Francisco Bay region ..... 2a. var. *typica*.
  - Corolla yellow or white; dried plants grayish-green in appearance. Southern California .... 2c. var. *bernardina*

Calyx-lobes linear or linear-lanceolate.
- Inflorescence strictly virgate. Northern California ..... 2d. var. *virgata*
- Inflorescence not strictly virgate, but more or less spreading.
  - Corolla blue or bluish-white; leaves densely white-hairy ..... 2e. var. *jacintensis*
  - Corolla not blue; leaves not white-hairy.
    - Basal leaves mostly 3-10 mm. wide, cauline leaves not much reduced. Southern California ..... 2f. var. *patula*.
    - Basal leaves 8-20 mm. wide, cauline leaves few and much reduced. Central and northern California ..... 2g. var. *cycna*

Page 158, line 8: "comb." not "Comb."

Page 159, line 17 from bottom: Change semicolon to comma before "*Munz 2256*".

Page 170, line 10, comma instead of period after "*Hubbyi*". Line 12 from bottom: Citation of Phacelia hispida Gray, should read Syn. Fl. 2^1:161. (Meaning Vol. 2, part 1.)

Page 171: Reorganize key as follows:

Plant stout, grayish and shaggy hirsute throughout; racemes very dense especially in fruit. Ojai Valley to San Fernando ..... 1c. var. *Hubbyi*

Plant greener below; fruiting racemes more or less open.

Flowers separated, evenly spaced; stems weak; seeds 2 or 3. San Gabriel Mts. ..... 1b. var. *eximia*.

Flowers close together.

Seeds 4, 3-sided.

Seeds 3 mm. long, 1.5 mm. wide. Interior Valley of Calif. to Ft. Tejon ..... 1d. var. *cicutaria*

Seeds not exceeding 1.5 mm. in length. Calif. from Paso Robles southward to Lower Calif. ..... 1a. var. *genuina*

Seeds 2, oval, flattened, 3 mm. long, 2 mm. wide. Butte Co., Calif. ..... le. var. *heterosepala*

Page 171, line 7 from bottom: Change semicolon to comma before "*Eastwood, June 13, 1902*".

Page 174, line 10: Spell *hispida* not *hispada*. Line 17: "seeds 4, 1.5-2 mm. long".

The errors, above corrected, were due to the editor's inadvertent failure to submit proof, or page proof, to the authors.

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