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CALIFORNIA ACADEMY

OF

SCIENCES.

ADDITIONS TO THE FAUNA OF SAN DIEGO.

BY CARL H. EIGENMANN & ROSA S. EIGENMANN.

Within the past five months the conditions for the study of the ichthyological fauna of San Diego have become very favorable. Before that time each fisherman disposed of his catch as best he could; now practically all the fish caught are brought into two markets where we are enabled to examine the catch of each day as it is unloaded. To these conditions we owe the ability to enumerate many forms which are either new or have not before been found near San Diego. We are under many obligations to the fishermen who always desire to preserve strange forms for us, and whose knowledge in certain cases even a professional ichthyologist might envy.

The types here enumerated will be deposited in the U. S. National Museum, the Museum of the California Academy of Sciences, and in our private collections. The catalogue numbers given in this paper refer to the register of the California Academy of Sciences.

We are indebted to Mr. S. Garman for tracings of various figures of Scopeloids otherwise inaccessible to us.

CYPRINIDÆ.

1. **Phoxinus (Tigoma) orcuttii** sp. nov.

Types, over one hundred specimens, the largest .062 m. in length. Temecula River and tributaries. C. R. Orcutt, collector. Oct. 22, 1889. Catalogue No. 1011.

While camping Mr. Orcutt discovered a large number of fishes in a river about fifteen miles southeast of Temecula station. By using a blanket as a seine a number were secured. Leaving out of consideration the *Gasterosteus microcephalus* which enters rivers, but is properly a brackish water species, *Ph. orcuttii* is the second* species of fresh-water fish recorded from the western slopes of San Diego county. Judging from its large sandy bed, the river in which this species was discovered is evidently of considerable size during the rainy season. At the time it was visited it was but three to five feet wide, and a few inches deep. In places it disappeared entirely under the sand. At Temecula station in the Temecula river this species is still more abundant than in the mountains.

Related to *Ph. egregius* and *lineatus* Grd.

Head, 3½–4; depth, 4–4½; D. 8½; A. 7½; lat. l. 58; teeth 1 (rarely) or 2, 5–4, 1 or (rarely) 2.

Moderately compressed; head sub-conical, scarcely wider than high, its depth equal to head, less snout; eye large, 3½ (in smaller specimens) to 4½ in the head, 1½ in interorbital; maxillary reaching to front of eye.

Lateral line complete; little decurved.

Origin of dorsal fin equidistant from base of middle caudal rays and pupil; height of dorsal equal to length of head less snout, but little less than the head in smallest specimens. Caudal widely forked, the lobes equal, a little higher than the dorsal. Anal, 1½–1⅓ in head. Ventrals

**Salmo irideus* is found in Pala Creek.

inserted slightly anterior to the dorsal fin, their tips reaching the vent, not to anal. Pectoral fins $1\frac{1}{2}$–$1\frac{1}{3}$ in head, not nearly reaching the ventrals.

Upper teeth strongly hooked, the lower more conical; the tips of all the teeth black in fresh specimens.

Peritoneum black; intestinal tract little longer than the total length.

A conspicuous plumbeus lateral band nearly as wide as depth of eye extending from shoulder to base of caudal; a triangular blackish spot on base of caudal; top of head and back downward to lateral band dark gray; ventral surface below lateral band pinkish in life: sides and middle of head with black dots; caudal smutty, other fins plain.

SCOPELIDÆ.

The members of this family seem to be quite abundant. They descend to deep water in stormy weather, and are then eaten in quantity by the rock-cods, from whose mouths all the members so far known from this region were taken. They are more restricted in their habitat than might be expected. None of the species taken within twenty miles of Point Loma, with one doubtful exception, were found on Cortes Banks, and the three species collected on those banks have not, as yet, been taken near Point Loma.

Diaphus gen. nov.

Type: *Diaphus theta* sp. nov.

Characters of *Myctophum;* phosphorescent spots divided into halves by a median black line.

The phosphorescent spots being very important characters in the family *Scopelidæ*, their peculiar modification in the species described below seemed to us to be of generic value.

To this genus should be referred *Scopelus engraulis* Günther, Challenger Report, Deep Sea Fishes, 197.

2. **Diaphus theta** sp. nov.

Types, eleven specimens, .033–.065 m. long: from the mouths of several species of *Sebastodes*. Off Point Loma. C. H. E., collector. Catalogue No. 1003.

Head, 3–3½; depth, 3½–4; D. 11–13; A. 9–12; lat. l. 34.

General shape of the head as in *M. mülleri* (see Goode, Hist. Aquat. Animals, pl. 203), the tail deeper; the pectoral placed lower.

Compressed, deepest at nape, tapering evenly above and below to the caudal peduncle, whose depth is equal to half the greatest depth. Head short and deep, its depth $1\frac{1}{5}$ in its length; profile convex, not encroached upon by the low supraorbitals; nasal ridge inconspicuous.

Orbit 3 in head, ¾ in interorbital.

Preopercle little more oblique than in *M. californiense* and *mülleri*; maxillary 1⅓ in the head.

Scales entire.

Origin of dorsal fin little nearer tip of snout than to origin of caudal; base of dorsal 2–2½ in distance from base of middle caudal rays to last dorsal ray, which is slightly in advance of the origin of the anal; adipose fin equidistant from base of middle caudal rays and last dorsal ray; ventrals reaching little beyond origin of anal; pectorals minute, not reaching ventrals in large specimens; placed very low, little higher than in *M. brachychir.*

A conspicuous phosphorescent spot on snout just in front of each eye (the remainder of those on head somewhat obscured through digestion); five pairs of phosphorescent spots on breast, five pairs on belly, fourteen pairs from origin of anal to caudal, none on base of middle caudal rays, the remaining spots as in *californiense* with an additional one just above the fourth pair on the breast (some of those on shoulder probably obliterated); no white blotches or spines about caudal peduncle.

Black, scales strikingly cœrulescent; fins light.

STENOBRACHIUS subg. nov.

Type, *Myctophum leucopsarum* sp. nov.

The comparatively small eye and enlarged scales of the lateral line would place this species in the genus *Alysia* Low. It does not appear to us that the differences are of sufficient importance to warrant more than a subgeneric separation from *Myctophum*. As the name *Alysia* is preoccupied, and we are not able to examine specimens of the type of *Alysia*, we propose *Stenobrachius* as a subgeneric or generic name for this species, in allusion to the very narrow pectorals.

3. **Myctophum (Stenobrachius) leucopsarum** sp. nov.

Types, 23 specimens .035–.100 m. long: from the mouths of species of *Sebastodes* taken off Point Loma. C. H. E., collector. Catalogue No. 1007.

Head $3\frac{1}{2}$–$3\frac{3}{4}$; depth $4\frac{2}{3}$–$5\frac{1}{2}$; D. 12–15; A. 14 or 15; Lat. l. 36.

General form of *Myctophum townsendi* Eigenm. & Eigenm. Deep forward, tapering evenly to the caudal peduncle, whose depth is one-half the greatest depth.

Head long and pointed, its superior and inferior profiles nearly equally inclined. Mouth large, maxillary reaching edge of preopercle, considerably dilated behind, $1\frac{2}{5}$–$1\frac{1}{2}$ in head. Eye comparatively small, orbit $3\frac{1}{2}$ in head, 1 in interorbital. Interorbital with a slight median ridge, a groove on either side of it. Nasal ridge comparatively small. Preopercular margin oblique.

Origin of dorsal nearer tip of snout than to base of caudal, behind the ventrals; last dorsal ray over third or fourth anal ray. Base of dorsal 2⅓ in its distance from the middle caudal ray. Highest dorsal ray equals head minus opercle. Adipose fin nearer dorsal than caudal. A white area just in front of the caudal on the dorsal surface, another on the ventral surface. Phosphorescent spots arranged as in *M. californiense*, the three about the pectoral forming a straight vertical line instead of a triangle.

Scales very thin, silvery or but slightly cœrulescent, those of the lateral line much deeper than the others, twice as large as those on the tail, about ⅓ larger than those of the body.

Light, dotted with black, appearing lighter than any other species of this family found about San Diego.

Mr. Samuel Garman has kindly sent us tracings of *Myctophum coruscans* and *hians*. In *leucopsarum* the scales of the lateral line are not so deep, the snout sharper, the pectoral narrower and placed lower than in *coruscans*, which is identical with the type of *Alysia*.

Tarletonbeania gen. nov.

Type: *Tarletonbeania tenua* sp. nov.

Related to *Myctophum*, differing from related genera in having no externally developed lateral line.

Anal basis much longer than dorsal. Pectoral placed high as in *Myctophum*. Caudal peduncle extremely slender.

Myctophum crenulare Jordan & Gilbert probably belongs to this genus. Dr. Gilbert informs us that it has no lateral line. It seems to have been nearly simultaneously described by J. & G. and by Dr. Tarleton H. Bean, for whom this genus is named.

4. **Tarletonbeania tenua** sp. nov.

Type: a single specimen .073 m. October 31st, 1889. C. H. E., collector. The single specimen was taken out of the mouth of *Sebastodes miniatus*. It probably came from near the Coronado Islands.

Head $3\frac{3}{4}$; depth $4\frac{1}{3}$; D. 12; A. 17.

Greatly compressed; highest at shoulders, tapering to the very slender caudal peduncle, whose depth is $4\frac{1}{2}$ in the greatest depth, its width a little more than half its height. Ventral and dorsal outlines equally arched. Head as in *Myctophum californiense;* the preopercular margin little inclined.

Scales of back and belly rather small, those of the sides much larger, the smaller scales strongly denticulate; the larger ones crenulate, all thin, deciduous.

Origin of dorsal equidistant from tip of snout and base of caudal; adipose fin nearer dorsal than caudal. Length of caudal equal to the base of the dorsal. Anal basis long, 4 in the length. Ventrals reaching half way to seventh anal ray; pectorals to ventrals.

No spines above or below on the caudal peduncle.

Five pairs of phosphorescent spots in front of the ventrals; six pairs between ventrals and anal; sixteen between the origin of the anal and caudal; one spot above the last of those along the base of the anal; three extending in an oblique series from the last of the abdominal spots upward and backward; one above the first of the abdominal spots; one on the lower margin of the anal basis; another in front of the middle of the pectoral, below which is another near the ventral series.

This specimen differs from the description of *M. crenulare* in its equally arched dorsal and ventral outlines; in the absence of spines on the caudal peduncle above and below; in the position of the dorsal and size of the ventrals.

5. **Euthynnus pelamys** (L.)

Thynnus pelamys C. & V. Hist. Nat. Poiss. VIII, 112, 1831 (Rio Janeiro).

Orcynus pelamys Poey, Syn. Pisc. Cub. 362, 1868; id. Enum. Pisc. Cub. (Cuba).

Sarda pelamys Gill. Cat. Fish. East Coast N. A. 24, 1873 (Cape Cod to Florida).

Euthynnus pelamys Jordan & Gilbert, Syn. Fish, N. Am. 430, 1883 (copied); Jordan, Cat. Fish. N. Am. 69, 1885; id. Proc. U. S. Nat. Mus. 1886, 574.

This species has hitherto been known from the warm parts of the Atlantic Ocean, the Indian Ocean and Japan. A single specimen, .47 m., was brought into the San Diego market Oct. 31, 1889, another Dec. 15, 1889, by the Portuguese fishermen. It was pointed out as something rare, and with the statement that it was common in Portugal. It was provisionally identified with *E. pelamys* (L.), though it differs from the description of that species in having no teeth on the palate, and but seven dorsal finlets, and from the figure in Goode, History of Aquatic Animals, pl. 95 b., in having the lateral streaks of the side continued forward to the shoulder.

Head, $3\frac{2}{5}$ to end of middle caudal rays; depth, $3\frac{5}{6}$; D. XV—I, 14+VII; A. II, 12+VII.

Metallic blue above, sides white with four black stripes extending from the shoulder-girdle backward, the lower ones decurved.

Somewhat heavier than *Sarda chilensis*. Head conical, mouth moderate, the maxillary extending to below the middle of the eye; no teeth on vomer or palate; jaws each with a series of fine, sharp, recurved teeth. Eye large, with anterior and posterior adipose lid, $1\frac{3}{5}$ in snout, 6 in head, about 2 in interocular. Dorsals and anal falcate. Pectorals reaching vertical from 10th dorsal spine.

Corselet well developed, the scales extending along the base of the dorsals and ventrals, and along the lateral line; otherwise naked.

SCLÆNIDÆ.

6. **Genyonemus lineatus** (Ayres).

This species, while it was known to be abundant on the coast of California, does not seem to have been recorded from San Diego. It was common in the bay on December 27th, and spawns in February.

DITREMIDÆ.

According to modern rules of nomenclature the name *Embiotocidæ* is not tenable, the name *Embiotoca* being a synonym of the objectionable *Ditrema*.

7. **Damalichthys argyrosomus** Girard.

This species, not before recorded from San Diego, is not uncommon on the ocean shore, and enters the bay. It was first observed December 8, 1889, and has been noticed at several different times during the remainder of the month.

8. **Amphistichus rhodoterus** (Agassiz).

One ♂, .19 m. January 10, 1890. With *Amphistichus argenteus* Agassiz.

Silvery, the body profusely covered from dorsal to anal and ventral fins, with squarish, bronze spots, the color being exactly like that which forms bars and spots on *A. argenteus*, except that the brassy color in *argenteus* is modified only by black dots, while in *rhodoterus* the brassy color is modified by both black and scarlet dots, the scarlet making the sides appear to be strongly tinged with red. The brassy ground color of the spots is not resolved into dots by the aid of a pocket lens, but appears as if evenly applied, and the red and black dots sprinkled upon it. Dorsal surface backward to insertion of dorsal fin, olive; a blue metallic reflection above lat. line from nape backward. Ventral surface backward to base of ventrals strongly scarlet-tinged, the red and black dots aggregated on the breast to form crescents parallel with the scale margins; premaxillary posteriorily, and maxillary, checks and opercles also strongly red-tinged, this region and the breast appearing, at a glance, to be "bloodshot."

All the fins, except the pectoral, blackish at tips and reddish-tinged; an olive streak through the dorsals which is most conspicuous anteriorly. Pectorals reddish at base, otherwise plain amd slightly olivaceous.

D. XI, 27; A. III, 30; depth, 2; head, $3\frac{3}{5}$; lat. l. 68.

Ennichthys heermanni Girard is not a synonym of this species. It probably is identical with *Amphistichus argenteus* Agassiz. The proportions, color, etc., agree with *Amphistichus argenteus* Agassiz, but not with *A. rhodoterus* Agassiz.

GOBIIDÆ.

9. **Clevelandia longipinnis** (Steindachner).

Gobiosoma longipinne Steind. Ichthyol. Beitr. VIII, 27, 1878 (Los Animas Bay). *Clevelandia longipinnis* Eigenm. and Eigenm. Proc. Cal. Acad. Sci. 2d Ser., Vol. I, 73, 1888 (San Francisco).

This species has so far been known from three specimens in Dr. Steindachner's collections from Las Animas Bay, Gulf of California, and a single specimen from San Francisco.

We find it to be the commonest fish in San Diego Bay where it is found in all the little pools between high and low tide marks.

The diagnosis of the genus *Clevelandia* may be augmented with the statement that the skull is convex in transverse profile without a trace of a median ridge. Jenkins and Evermann, in an apparently hastily prepared paper (Proc. U. S. Nat. Mus. 1888, 150), considered *Clevelandia* identical with *Gillichthys*.

10. **Lepidogobius** (or gen. nov.) **y-cauda** (Jenkins & Evermann).

Gillichtys y-cauda, J. & E. Proc. U. S. Nat. Mus. 1888, 147 (Guaymas)

This species has been recorded from Guaymas only. It is also found in San Diego Bay, nearer low water mark than *C. longipinnis*, and was considered a new species by us. Dr. Gilbert has examined some of the typical specimens, and informs us that they have the dermal shoulder flaps of *Lepidogobius* and bands of teeth instead of single series as stated by Jenkins & Evermann. A comparison of the skulls of this species, and of *Lepidogobius lepidus*, is necessary to determine its generic position. It greatly resembles that of *Gillichthys*.

SCORPÆNIDÆ.

The members of this family, or at least of the genus *Sebastodes*, seem to live at definite depths and on bottom peculiar to each species or group of species. This does not imply that their distribution is narrowly limited, but that a given species may be found or not at any point within the limits of its habitat, as the peculiarities of the bottom at a given depth are fitted for it or not. To this cause is to be attributed, in part, the fact that so many northern forms have but lately been added to the fauna of San Diego, and that a given species may be caught for several days in succession, and then not appear again for some time. As the different rock-cod boats have found new conditions, even within a few hundred yards of their usual fishing grounds, they invariably have brought novelties. Thus, on one day, *S. proriger*, *rufus*, *eos* and *melanostomus*, the first one "rare," the others new, were all brought by one boat which had accidentally found new conditions. *S. melanostomus* has not since been found, *proriger* has been caught but once, while *eos* and *rufus* have occasionally been found since. *S. ruber* and *levis* are frequently associated, while *rubrovinctus*, *elongatus*, *chlorostictus*, *constellatus*, *rosaceus*, *vexillaris*, *chrysomelas* and *serriceps* form another group.

11. **Sebastodes goodei** sp. nov.

Closely related to *S. flavidus* and *S. paucispinis*. Locally abundant off Point Loma. Many were brought into the market January 10, 1890, with a species of *Eopsetta*. Others were caught the 29th. The largest seen 22 inches long. C. H. E. collector.

Catalogue No. 1056.

D. XIII, 14; A. III, 8; head $2\frac{5}{6}$–3; depth, $3\frac{2}{5}$–$3\frac{2}{3}$; lat. l. 54 (pores).

Elongate slender, form of *flavidus*, *proriger*, and *elongatus*. Head pointed, the mandible projecting and entering the profile as in *flavidus*. Skull as in *paucispinis*, the occipital ridges ending in spines, the parietals not meeting above the supra-occipital as they do in *flavidus;* no other cranial spines evident. Mouth large, maxillary reaching to anterior margin of pupil (posterior margin of orbit in *paucispinis*); $2\frac{2}{5}$ in head ($1\frac{3}{4}$ in *paucispinis*).

Orbit little longer than snout ($1\frac{1}{2}$ in snout in *paucispinis* of same size) 4–$4\frac{1}{3}$ in head, equal to the interocular, little greater than the interorbital. Preorbital narrow, $\frac{2}{7}$ of orbit, with 2 or 3 spines, the posterior one or two directed backward.

Preopercular spines strong, the two lower slender, distinct.

Scales small as in *paucispinis;* jaws and tip of snout finely scaled.

Dorsal spines slender, the highest about 3 in head. A deep notch between the spinous and soft dorsal fins.

Caudal deeply forked, the middle rays about half as long as the longest. Anal spines very short, graduated, the second little more than half an orbital diameter, much lower than in *flavidus*, the rays low, not twice as high as second spine. Ventrals short, reaching half way to base of 3d dorsal spine.

Pectoral lanceolate, reaching midway between tip of ventral and vent.

Gill-rakers slender, the longest 2 in orbit.

Peritoneum white.

Color clear vermilion, the back a little darker than the sides, the belly whitish. Anal, pectoral and ventral fins vermilion, the membranes of the dorsal dusky-yellowish. Caudal vermilion, somewhat dusky. No black anywhere.

Dedicated to Dr. G. Brown Goode, in charge of the United States National Museum.

This species being intermediate between *paucispinis* and *flavidus*, that is between *Sebastodes* and *Sebastichtys*, the genus *Sebastodes* will either have to be merged with *Sebastichthys*, or the latter divided into other genera.

12. **Sebastodes rufus** sp. nov.

Several specimens of this species were taken off Point Loma in 100 fathoms of water, November 14, 1889. Others have since been brought into the markets. It is evidently closely allied to *S. ovalis* and *S. entomelas*.

For comparison we have a specimen of *S. ovalis* .37 m. long taken on the Cortes Banks in 45 fathoms, July, 1889.

The specimens of *S. rufus* are: one .54 m. long taken off Point Loma November 14, and one .37 m. long taken December 10 at the same place. We have no *bona fide* specimens of *S. entomelas* and have used both the original description* and the modified description in Jordan & Gilbert's Synopsis of North American Fishes.

Head 3; depth 3½ (3⅔ in ovalis); D. XIII, 14½; A. III, 8½; 56 pores in lateral line.

Compressed, elongate; profile straight, less steep than in *ovalis*, the snout broader. Maxillary reaching to middle or little beyond middle of eye. Mandible with a prominent symphyseal knob. Interorbital slightly convex, as wide as orbit in smaller specimen, wider in the larger. Preocular, supraocular, postocular, tympanic and occipital spines present, the last with a distinct spine at tip; the occipital ridges higher, narrower, more diverging and more conspicuous than in *ovalis*. The preocular as fully developed as in *ovalis*. (The postocular absent in *entomelas*.)

Eye moderate, orbit slightly longer than snout, 3½–4 in head.

Preorbital very narrow, about 4 in the orbit, with two small backward-directed spines; (no spines in *entomelas*.) Preopercular spines long and slender, all of them longer and stronger than in *ovalis*, the lower two very long, the second reaching beyond base of third, not nearly reaching base of third in *ovalis*. ("The two lower obsolete" in *entomelas*.)

Head entirely covered with moderate sized scales, those of the body larger.

Outline of spinous dorsal little arched, the highest spine slightly more than 3 (2½ in *ovalis*) in the head, the high-

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* Proc. U. S. Nat. Mus., 1880, 142.

est ray about equal to the highest spine. Caudal emarginate. Anal spines graduated, the second equal to the highest dorsal spine.

Rufous, variously marked with brown. Lateral line rufous. Upper angle of opercle, a line from eye downward and backward to upper half of pectoral, another parallel to it from upper angle of maxillary backward, and tip of jaws dark brown; these markings conspicuous; head otherwise rufous. Axil black. Margin of spinous dorsal and greater part of membranes of soft dorsal black. Base of dorsals rufous, spotted with darker. Caudal dusky. Membranes of the remaining fins chiefly black, the rays rufous. Peritoneum jet black.

13. **Sebastodes proriger** Jordan & Gilbert.

Five specimens of this species were brought into the San Diego markets November 14, 1889. They were said to have come from a depth of 100 fathoms, where they were associated with large specimens of *rufus*, *melanostomus* and *eos*.

Description of a specimen .60 m. long.

Head 3 in the total length; depth $3\frac{3}{4}$; D. XIII, $13\frac{1}{2}$; A. III, $7\frac{1}{2}$.

Elongate. Head pointed, the lower jaw projecting. Maxillary reaching to below posterior margin of eye, 2 in head. Interorbital slightly convex, without ridges. Cranial ridges low, obscure, but all terminating in sharp spines; pre-, supra- and postocular, tympanic and occipital spines present. Eye small; orbit $1\frac{2}{5}$ in snout, $4\frac{3}{4}$ in head, $1\frac{1}{6}$ in interorbital. Preorbital $\frac{3}{5}$ of an orbital diameter, with 3 retrorse spines below, the posterior the smallest; a retrorse spine just below the orbit. Opercular spines simple and strong.

Mandible, maxillaries, suborbitals and entire snout scaled. Scales of the head small and strongly ctenoid, those of the body larger.

Outline of spinous dorsal regularly arched, the 4th and 5th spines highest, 3 in the head; highest articulate ray $3\frac{2}{5}$ in the head. Anal spines graduated, the second being stronger but considerably shorter than the third, which is $5\frac{1}{3}$ in the head; highest ray 3 in the head. Pectorals extending somewhat beyond the ventrals.

Peritoneum black. Top of head and back chiefly black, lateral line vermilion; a blackish band just below the lateral line becoming much wider forward and extending on the sides below the fifth dorsal spine.

A large opercular spot, a broad band downward and backward from eye, a narrow one across cheeks below the eye, lips and tip of lower jaw chiefly black; the rest of the head and sides chiefly vermilion. Anal and ventrals vermilion; pectorals and caudal blackish; dorsals nearly black. Axils dusky.

14. Sebastodes pinniger (Gill).

This species has hitherto been known from Monterey northward. We can extend its distribution 400 miles. A single individual .55 m. long was taken off Point Loma December 3, 1889, another December 5, 1889, and another December 10. They came from a depth of about 100 fathoms.

This species is very common in the waters of the northern parts of California. In the south it is replaced by *S. miniatus*. The latter species is usually much redder, but a tolerably complete gradation exists, as many specimens of *miniatus* have the red replaced by lemon yellow. There is also an intergradation in the roughness of the mandibulary scales.

The life colors of *pinniger* are: dorsal spines and anterior part of membrane flesh colored, posterior half of membrane orange. Second dorsal and caudal orange. The remaining fins with the rays flesh colored, the membranes orange. Belly salmon. Sides and back lemon yellow mottled with gray. Lateral line flesh color. Lower part of head rose pink, 3 lemon yellow bars on sides of head. A band of madder brown between eyes, one across nape and one across tip of snout; regions between them madder brown mottled with orange. Membranes between the jaws and between the maxillaries black.

15. **Sebastodes melanostomus** sp. nov.

One specimen .54 m. off Point Loma, November 14, 1889, 100 fathoms.

Closely related to *S. ruber*, having smooth cranial ridges and black peritoneum.

Head $3\frac{1}{4}$ in the total length; depth .19 m.; D. XIII. $13\frac{1}{2}$; A. III. $7\frac{1}{2}$; lat. l. 43.

Short and deep; head heavy; mouth large, lower jaw projecting, maxillary reaching to below posterior border of pupil. Eye very large, orbit 1 in snout, $3\frac{5}{6}$ in head. Interorbital space slightly depressed, $4\frac{3}{4}$ in the head. Preorbital narrow, 3 in the orbit, with an anterior simple, and a posterior many-pointed spine. Cranial spines low but distinct, smooth, and covered with skin to their tip. The three ocular, the tympanic and occipital spines present. Opercular and preopercular spines long, simple. Maxillary, mandible, preorbital and snout scaly. Scales of the opercle rather large. Scales of the sides very large, with but few accessory ones. Gill-rakes slender, $\frac{2}{7}$ of an orbital diameter long.

Dorsal spines all very low, the 3d and 4th the highest, less than an orbital diameter; the soft rays 3 in the head. Anal spines graduated, the second not much more than half the length of the soft rays.

Peritoneum black.

Body scarlet, shading into madder brown or blackish-red above lateral line. Fins vermilion, the first dorsal with its membranes narrowly black edged. All other fins more or less black on posterior half, the caudal most so. Head vermilion, tinged with black. Inside of mouth and gill cavity almost wholly black. Upper posterior portion of gill membranes black. A black bar above opercle.

16. **Sebastodes eos** sp. nov.

A single specimen, .54 m., was taken off Point Loma in 100 fathoms, November 14, 1889. Many others have since been observed.

This species is evidently closely related to *S. chlorostictus* and *rhodochloris*. It reaches a much larger size than either of those species has been known to attain. The scaly mandible serves at once to distinguish it from *chlorostictus*, while this character and the short second anal spine distinguish it from *rhodochloris*.

Head 2½, (3–3⅙ in the total length); depth 3 (3½–3¾); D. XIII, 13½; A. III, 6½; lat. l. 37.

Oblong. Lower jaw included, its symphyseal knob strong. Maxillary reaching beyond eye, 2 in the head. Orbit 1 in snout, little more than four times in head, greater than interorbital width.

Interorbital deeply concave, grooved medially, 5½ in head.

Cranial ridges very high and narrow, ending in prominent spines; preocular, supraocular and tympanic spines directed outward and backward; postocular upward and backward. Occipital ridges in largest specimens 6 mm.

high, the region between them depressed. Opercular and preopercular spines long and strong.

Gill-rakers all short, the longest one-fifth orbital diameter.

Mandible, maxillary and snout, except a median triangular spot, scaly. Accessory scales very numerous on cheeks and opercles.

Preorbital little less than half width of orbit, with a single, flat downward directed spine at its posterior angle (sinuate in *chlorostictus*).

Spinous dorsal deeply incised, the membrane of the fifth spine meeting the sixth spine near its basal fourth, less deeply incised in smaller specimens, the highest spine 2–2½ in head; highest dorsal ray, 2¾–3 in head. Second anal spine 2⅔–3 in head; highest anal ray, 2⅓–2½. Pectorals reaching to twelfth dorsal spine, 4⅔–5 in the total length.

Color marks all having a washed or faded appearance. Body and head intense rose pink. Back and dorsal fin indistinctly marked with raw sienna; fins colored like the body. Three pink spots, one below origin of soft dorsal, one below its end, one above the lateral line below the ninth dorsal spine. Membranes between maxillaries saturn red. Peritoneum perfectly white, or more or less dusky.

A specimen of this species .42 m. long taken December 10, 1889, in 100 fathoms off Point Loma, presents the following characters as compared with a specimen of *S. chlorostictus*, .38 m. long, taken July 29, 1889, in 45 fathoms of water at the Cortes Banks:

S. eos.	*S. chlorostictus.*
Mandible scaled, except about the pores.	Mandible entirely naked.
Maxillary pretty evenly scaled.	Maxillary with a few scales above.
Preorbital with a posterior spine only, which on one side is forked at the tip.	Preorbital with an anterior simple spine, or a posterior sinuate 3 to 4-pointed spine.
Interorbital flattish, with a deep median groove, $1\frac{2}{5}$ in orbit.	Interorbital deeply concave with a deep median groove, $1\frac{3}{5}$ in orbit.
Orbit 4 in length of head.	Orbit, $3\frac{1}{2}$ in head.
Second preopercular spine directed downward and *forward.**	Second preopercular spine directed downward and backward.
Second anal spine $2\frac{2}{3}$ in length of head.	Second anal spine $2\frac{1}{5}$ in length of head.
Peritoneum white or dusky.	Peritoneum very dark.
Spots of back having a washed or faded appearance.	Green spots on back well defined.

17. **Sebastodes æreus** sp. nov. (= *umbrosus?*)

Two specimens of this species were brought into the San Diego markets on November 7, 1889. They came from near the Coronado Islands and measure .26 and .28 m. Others were procured January 9 and 24.

Catalogue No. 1070.

Closely related to *S. rhodochloris* J. & G.

Head $2\frac{2}{3}$–$2\frac{3}{4}$; depth $2\frac{3}{4}$–3; D. XIII, $12\frac{1}{2}$–13; A. III, $6\frac{1}{2}$; lat. l. (pores) 37–40.

Shape of *S. rosaceus*. Jaws equal, maxillary reaching past pupil, 2 or slightly less than 2 in the head. Preorbital narrow, with *three* flat spines. Eye large, $3\frac{1}{2}$–$3\frac{3}{4}$ in the head, $\frac{3}{5}$ in interorbital.

Cranial ridges high and narrow, terminating in sharp spines; pre-, supra- and postocular, tympanic and occipital spines. Interorbital concave, with a narrow median groove bordered by narrow ridges.

Maxillary and mandible entirely scaled.

Highest dorsal spine $2\frac{1}{5}$ in the head. Second anal spine

*This seems to be an individual character.

little longer than the third, considerably shorter than the rays, 2⅓ in the head.

General color (in life) pink overlaid with bronze. Top of head and back above lateral line bronze with five pink spots; sides below the lateral line finely vermiculated with bronze, which occupies more space than the ground color. Pink spots of the back placed as in related species, not surrounded by green or purple; posterior part of lateral line pink. Sides of head bronze (pink showing through) with an ill-defined streak backward from upper angle of eye; a light pink spot on upper angle of gill opening; head below orbit pink, with a bronze bar through the cheeks; maxillary pink, with a median bronze streak; membranes of the maxillaries chiefly bronze. Lower surface of head rose colored; breast yellowish-pink, abdomen nearly white, area above anal yellowish. Dorsal light bluish-pink clouded with bronze, the rays of all the other fins pink, the membranes bronze.

GADIDÆ.

18. **Merlucius productus** (Ayres).

This species is common on the shores of northern California. It has not been recorded south of Santa Barbara.

A single specimen was brought into the San Diego market November 6, 1889. It came from off Point Loma. Others have since been observed.

COTTIDÆ.

19. **Leiocottus hirundo** Girard.

A single specimen of this species, of which Jordan & Gilbert (Synopsis Fish. N. A., 712) say: "Santa Barbara Islands; extremely local" was taken in San Diego Bay, January 31, 1890.

PLEURONECTIDÆ.

20. **Hppoglossina stomata** sp. nov.

Two specimens of this species were obtained in deep water off San Diego, November 7, 1889. Both females, one with ripe eggs.

Related to *H. macrops* Steind., with much larger mouth, etc.

Head 3, or slightly less than 3, in the length; depth $2\frac{1}{2}$–$2\frac{2}{5}$; D. 67–70; A. 52–54; lat. l. 80. Sinistral.

Elongate elliptical, the profile depressed over the eye. Eye* large, 5 in head; lower orbit slightly in advance of upper; interorbital a narrow ridge.

Mouth large, maxillary extending to posterior margin of eye, as long as or longer than the pectoral, 2 in head; lower jaw about $1\frac{3}{4}$ in the head. Teeth small, uniserial. Anterior nares of both sides with long dermal flaps.

Scales of the left side all ctenoid, those of the right side cycloid on the anterior one-half or two-thirds of the body. Middle third of the interorbital naked, the anterior and posterior thirds scaled.

Dorsal beginning over middle of eye, the anterior rays with but one or two scales, the rest scaled to near the tip, all but the last 8 rays simple. Anal similar to the dorsal, with a strong procumbent spine. Highest dorsal and anal rays about $3\frac{1}{3}$ in the head. Pectoral of the colored side about 2 in the head, that of the blind side shorter. Caudal double-truncate, 5–$5\frac{1}{2}$ in the length.

Brown, strongly tinged in life with robin's-egg blue; numerous spots of light-blue and light and dark brown. Five pairs of large dark-brown ocelli along the dorsal and ventral parts of the eyed side, the alternate ones larger

*Eye *not* orbit.

and more conspicuous. Fins colored like the body, profusely mottled with light and dark; sinistral pectoral barred. A dark-brown spot above and below on the caudal peduncle just in front of the caudal shows conspicuously on the blind side.

The eggs are probably pelagic. They are transparent, and measure 1.2 mm. in diameter; the single oil globule measures .16 mm.

Two other species of this genus have been recorded from American seas. *H. macrops* Steindachner* from Mazatlan, Mexico, and from Trinidad Bay, Patagonia (Gthr.†); *H. microps* Gthr.† from the west coast of Patagonia.

21. **Eopsetta jordani** (Lockington) or sp. nov.

A single specimen of this species was taken with *Sebastichthys goodei* off Point Loma. It differs from the typical *jordani*, of which, however, we have no specimens in the following characters:

jordani.	*Sp. nov.*
Eye 3½ in head.	Eye 5½ in head.
Depth 2½ in the length.	Depth 2 in the length.
Vertebræ 11+32.	Vertebræ 11+31, including hypural plate.

These additions increase the number of fishes recorded from San Diego, including the Cortes Banks, to one hundred and sixty-three.

Remark: Several mistakes were made in our paper on "The Fishes of Cortes‡ Banks" which we wish to correct here.

NOTOSCOPELUS BRACHYCHIR E. & E. is the type of a

*Ichthyol. Beitr. v. 13, pl. III, 1876. †Voyage of H. M. S. Alert, 1881, p. 2.

‡Prof. George Davidson informs us that the older and correct spelling is Cortes, not Cortez.

new genus characterized by the low pectorals; it may stand as CATABLEMELLA gen. nov.

SEBASTICHTHYS MELANOPS should stand as *S. mystinus.*

SEBASTICHTHYS CARNATUS is probably *S. vexillaris.*

PARALICHTHYS CALIFORNICUS is not a *Paralichthys*, but a species of *Citharichthys.*

NOTES ON THE GEOLOGY AND PETROGRAPHY OF BAJA CALIFORNIA, MEXICO.

BY WALDEMAR LINDGREN, U. S. GEOL. SURVEY.

The expedition sent by the Academy of Sciences to Baja California in the spring of 1889 brought home, among other collections, some specimens of rocks from various parts of the territory.

Among these rocks, which Mr. Walter E. Bryant had the kindness to submit to my examination, were a few which seemed worthy of notice and description.

I. Crystalline Schists.

The first set of specimens from the Sta. Margarita and Magdalena Islands, opposite Magdalena Bay on the west coast in the southern part of the peninsula (lat. 24° 30′) principally consists of crystalline schists; among the rocks collected were found chloritic, slaty rocks, often containing garnet and magnetite; specimens of talc with serpentine; further, actinolite in long light green radiating prisms and an amphibolite, a slaty dark green rock, composed of prisms of greenish amphibole with scales of a white mica, probably muscovite.

The geological formation indicated by these specimens —highly compressed series of older schists—is remarkable as differing most decidedly from the geology of the mainland, indicated by Professor Gabb in a section from Magdalena Bay across to the Gulf Coast.

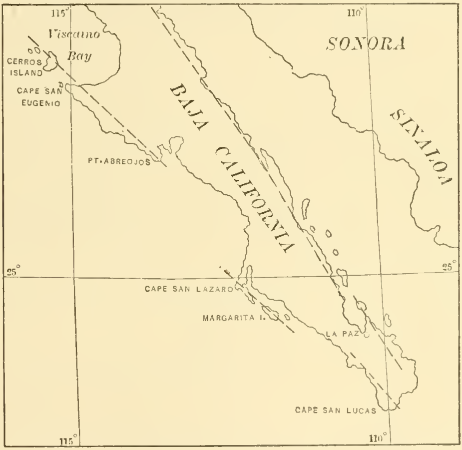
Along this section there is a gradual rise from the Pacific to a peninsular divide, from which an abrupt descent leads down to the shores of the Gulf of California.

The whole distance is occupied by horizontal or gently dipping soft shales and sandstones of cretaceous or tertiary age (mesa sandstones). These are again, especially near the Gulf, covered with recent eruptive masses. Metamorphic rocks do not make their appearance until further north, and then, according to Prof. Gabb's views, they are derived by regional or contact metamorphism—from the mesa-sandstones. On the whole, the general outline of the geology of the peninsula, given above, would be the same from La Paz to Sta. Gertrudis, that is from Lat. 24° to Lat. 28°. In general, we may characterize the structure as that of a gently ascending table land, broken near the eastern coast by a very considerable fault. This fault line may be very old, but at any rate a large dislocation occurred along it in post-cretaceous time.

It would be very singular if the occurrence of older schists were confined to a single point on the west coast of the peninsula.

However, consulting the excellent maps of the hydrographic office it is seen at a glance that the Sta. Margarita and Magdalena Islands, continued by the rocky mass of Cape San Lazaro, form a broken chain striking about N. 40° W., and extending for about 45 nautical miles Mr. Brandegee, who was a member of the expedition mentioned above, states that Magdalena Island has the same geological structure as Sta. Margarita, and that from its appearance Cape San Lazaro is also composed of similar rocks. The highest point on Sta. Margarita Island attains 1900′, while that of the Cape is about 1300′.

North of the cape the coast makes a bend eastward (see fig.) forming a long, shallow bay until at a distance of 130 nautical miles, and in a direction of about N. 30° W. Point Abreojos is reached. From here to Point San Eugenio (110 miles) the coast trends N. 45° W., and is occupied by a steep and high mountain range, continued northward for still 25 miles more by rocky islands, among which the largest is called Cerros or Cedros. The peaks of this range, which, from the bay to the north of it, I shall, to avoid repetition, designate as the Viscaino Range, rise to a height of about 3500′, while Cerros Island attains a maximum elevation of 3955′ (see map of hydrographic office). The range is separated from the main mass of the peninsula by a wide desert plain.



Sketch map of the southern half of the California peninsula. Dotted lines mark the trend of ranges and lines of dislocation.

Of the geology of the range proper we know as yet nothing, but its continuation northward, Cerros Island, is known from the description of Dr. John A. Veatch.* The island is composed of highly metamorphic slates,

*J. Ross Browne. Resources of the Pacific Slope, p. 143, San Francisco, 1869.

amphibolite and serpentine, together with granite and porphyries. Besides, basaltic flows and fossiliferous sandstone are mentioned.

In all probability, the range south of Cerros Island is in composition and age similar to the northern end, and the contrast between the more recent eastern range, forming the main mass of the peninsula, and this western older range of crystalline rocks is equally strong, as in the section from Sta. Margarita Island eastward. If we now examine the sea bottom between Point Abreojos and Cape San Lazaro by means of the soundings recorded on the hydrographic charts, it will be found that the thousand-fathom line which at Point San Eugenio runs within 15 miles of the shore, does not follow the coast line, but runs in a southeasterly direction till it again approaches the shore near Cape San Lazaro. Along a straight line between the two promontories the average depth is, according to the few soundings available, not more than 100 fathoms.

All these data speak strongly in favor of a submarine continuation of the Viscaino Range towards the Cape San Lazaro Range.

Going southward from Sta. Margarita the relations are somewhat similar. For about 80 miles southeast of the island, the low coast occupied by the mesa sandstones forms a slightly curved line; it then trends southward, and the Sierra de la Victoria, rising from the sea to a height of over 6000′, runs along it until at the rocky headland of San Lucas the southern end of the peninsula is reached.

The thousand-fathom line between Sta. Margarita and the northern end of Sierra de la Victoria forms a curve, concave towards the shore, and distant more than 30 miles from it. Along a direct line between the island

and the beginning of the Sierra the depth is nowhere over 100 fathoms. Of the geology of the extreme end of the peninsula very little is known, but according to the few data available it appears that granite and crystalline schists are the predominating rocks.* It can, of course, not be asserted that there are schists of the same series, and belonging to the same uplift as those of Sta. Margarita, but their occurrence in the line of strike of the latter is certainly suggestive.

In the southern part of the California peninsula there exists then, as far as our limited knowledge permits us to discern, two orographic lines of great importance:

1. A comparatively recent, probably post-cretaceous line of dislocation, extending from the vicinity of La Paz for many hundred miles northward along the eastern coast. There is, indeed, little doubt that this is the continuation of the fault line which I have described in a previous paper, relating to a section from Todos Santos Bay eastward, and which may be traced up to the line between the United States and Mexico. Very likely this is only a fresh break along an old line of disturbance, for a high range, composed of crystalline schists and granite continues in the same direction from the peninsula of La Paz southward.

2. A line along which an uplift of much greater age than the first one has taken place, and running near the western shore of the peninsula. It possibly extends as far as 400 miles from Cerros Island to Cape San Lucas. This line is indicated by several shorter ranges, mostly composed of crystalline schists and granite, but although its continuity is thus broken, it seems very probable, indeed, that these different parts are due to the action of one and the same orographic force. Very likely the range was

*Prof. Gabb's report, Appendix, I, Vol. I, Geology of California.

once continuous, and perhaps a part of the mesa sandstones have been derived from the destruction by erosion of this older area.

An interesting question in this connection is the configuration of the land-area, separating the Atlantic from the Pacific in Cretaceous time. Dr. C. A. White has pointed out that fossils of the Atlantic Cretaceous fauna have been found on the western side of the Sierra Madre on the mainland of Mexico, while the shore line of the Pacific Cretaceous ocean can be traced as far southward as Todos Santos Bay, at least.* Did this comparatively narrow isthmus continue southward, or did the two oceans meet some degrees south of the boundary line? Dr. White is inclined to regard the first mentioned view as the more probable, mainly on account of the great and marked difference between the fauna of the Atlantic and the Pacific Cretaceous, and it must be conceded that the existence of older ranges of crystalline rocks on the western side of the peninsula also speaks in favor of it. The question can only be satisfactorily settled by a more detailed investigation of the southern peninsula, and especially of the sedimentary series designated under the name of "mesa sandstones."

II. Basalt.

One or two specimens from the northern end of the peninsula, near Calamajuet on the gulf side at about Lat. 29° 30′, deserve special mention. Recent or tertiary volcanic flows in this vicinity overlie slaty, at least partly metamorphosed rocks. There are specimens of a slaty, dark-gray, fine-grained sandstone, locally used as whetstones; further of crumpled and folded talcose slates.

The volcanic rock is a dark-gray basalt with numerous

*Bulletin 15, p. 30, U. S. G. S.

reddish, decomposed olivines. Of most interest is, however, a basaltic, dark, brownish-gray, very vesicular rock of remarkable freshness and beauty, collected in the vicinity of Calamajuet. In the pores and cavities have crystallized a great number of hexagonal foils of brown mica of an almost metallic, bronze-like lustre.

In thin section the rock proves to be a nearly normal feldspar-olivine basalt of very fine-grained structure. The feldspar is a plagioclase, generally in the form of more or less slender laths with fine twin striation. The augite occurs as irregular grains or imperfectly idiomorphic in short prisms, and has the bamboo color so common among andesites and basalts. The brown mica, coating the cavities, is very sparingly represented in the mass of the rock; occasionally a foil of light-brown color, and not very strongly dichrotic, may be observed imbedded in the feldspar mass. The olivine, often partly decomposed into a dark-brown ferruginous mass, has the usual characteristics. Magnetite is frequent in smaller or larger crystals and grains, as is also apatite in long, colorless prisms.

In the feldspar, and apparently also in the augite, may be seen a considerable number of microlites of a rust-brown to coffee-brown color; they are of minute size, and when their thickness amounts to about half of that of the section, they are usually so dark in color as to be almost opaque. A distinct striation, evidently indicating a cleavage, may be seen on most of them; the refraction is of medium strength, the double refraction quite strong; the extinction is very nearly parallel to the principal extension and the cleavage, but can seldom be accurately measured on account of the interference of the feldspar mass. Pleochroismus, very slight; in fact, hardly appreciable. There is considerable difficulty in the interpretation of this mineral. It certainly is not biotite; from the form, habit, and other characteristics, I am very strongly inclined to regard it as a somewhat abnormal hornblende.

Microlites, evidently very similar to these, have been occasionally observed before,* and interpreted in the same way; the rocks were hornblende-basalts, and the microlites probably the result of a resorbing action of the magma on hornblende crystals of an older generation. It would be difficult to prove the same with regard to the rock in question, but it is at any rate certain that the mineral belongs to one of the very first generation of minerals.

To the constituents named above is added a small quantity of glass, wedged in between the feldspar crystals. The rock is not porphyritic, that is, contains no repeated generations of the same mineral; it is holocrystalline, with intersertal structure, and should be referred to Meissen type of basalts.†

It remains to describe the mica, coating the cavities of the basalt. This mineral, detached from the rock and mounted horizontally on a slide in Canada balsam appears as usually regular hexagonal foils of a light chestnut-brown color; between crossed nicols they do not remain dark, but show, on revolving the table, dark-gray or bluish colors, even when the crystal is of a minimal thickness, and which in thicker foils go over into the yellow colors of the first order. The pleochroismus is quite strong on oP (001): Rays vibrating parallel to $\mathfrak{b}$, or to $\infty P \breve{\infty}$ (010) are yellowish-brown; these parallel to $\mathfrak{c}$, or $\infty P \bar{\infty}$ (100) nearly colorless or slightly yellowish.

*L. Van Werveke, Neues Jahrbuch, 1879, p. 824. H. Sommerlad, Neues Jahrbuch, B. B., 1883, II, p. 139.

†Rosenbusch, Mass. Gesteine 1887, p. 725.

The color of the rays vibrating perpendicularly to oP, or parallel to $\mathfrak{a}$, observed on foils, imbedded in more or less vertical position in Canada balsam does not vary greatly from those parallel to $\mathfrak{c}$; the scheme of absorption would be $\mathfrak{b} > \mathfrak{a} = \mathfrak{c}$. In convergent light it is noticed that the angle of the optical axes is quite large, probably nearer 20° than 10°, and that the plane of the optical axes lies perpendicularly to the plane of symmetry, not as in biotite, parallel to it. The mineral, therefore, belongs to the micas of the "first-class," and is probably an *Anomite*. Twins are common among the mica crystals, as evidenced by the fact that apparently single foils between crossed nicols prove to be made up of two or more, turned at a certain angle with reference to each other.

A basalt very similar to this, and also containing anomite crystals in its cavities, has been described by L. Bucca from Italy.* As a rule micaceous feldspar basalts are very rare.

*Il monte de Roccamonfina, Bott. Com. Geol. Roma, 1886, Nos. 7 and 8.

DESCRIPTION OF A NEW COPÆODES.

BY W. G. WRIGHT.

Copæodes candida. ♂, expanse .85 to 1.1 inch. Both wings honey-yellow, immaculate, edged by a fine black line; fringe yellow. Secondaries, blackish at base; a dark ray from base along costa. Under side a little paler yellow; primaries black at base and for a little way along inner margin.

Types in author's museum.

Habitat, cañons in the foothills of southwestern California.

This species I first took in 1883, and nearly every year since then has added one or more examples to my collection. From the first I recognized it to be a new species, but I have kept it in abeyance until I should get a fair series, as I do not approve of the establishment of a species upon a single example. Having now, however, a dozen specimens, and all without variation, the species is entitled to recognition, and I have named it *candida*, signifying spotless, as in that respect it is faultless.

I judge that its nearest ally is *C. Eunus*, a northern mountain species with more black at base and rays toward margin; and that its nearest southern relative is *C. Wrightii*, a desert form with black sexual bar on disk of primaries, and light golden rays on under side of secondaries, by which marks they can readily be separated from *C. candida*.

All these species of Copæodes appear to be very local, and are scarce even in their own habitat—*C. Eunus* having been named from a single specimen, while of the others only a few examples are taken in a year.

DESCRIPTION OF A NEW SPECIES OF EUPROTOMICRUS.

BY ROSA SMITH EIGENMANN.

Euprotomicrus hyalinus. Type: One specimen .16 m. Pacific Ocean.

Very dark seal brown, the ventral surface definitely a little lighter, the margins of the caudal and of both dorsal fins hyaline, the ventral fins wholly hyaline, the pectoral mostly so, having the dorsal margin and a spot posteriorly black and a narrow, black basal band; the pectoral, ventral and caudal fins showing rays.

Teeth of the outer series of the lower jaw 17.

Base of first dorsal fin 5 in base of second, the dorsal fin interspace one-fifth greater than base of second fin.

Least height of caudal peduncle equal to vertical diameter of orbit, 2 in horizontal diameter. Orbit $1\frac{1}{5}$ in snout, its posterior edge over the mouth. Vertical diameter of spiracle $1\frac{1}{2}$ in vertical diameter of orbit.

Pectoral fin 2 in head, truncate, broader at tip than at base, which is about 2 in its length.

Head $5\frac{3}{5}$ in the total length; depth 9.

The specimen is in good condition, except that it has been badly shriveled by strong spirits. It belongs to the collection of the University of California, and was kindly loaned to me for description by Mr. J. J. Rivers, the Curator, who makes the following statement concerning it: "The shark was given to me by Lieutenant F. A. Gardner of the Pacific Mail Steamship Gaelic that runs between San Francisco and China. It was stranded upon the deck of the steamer, having been carried there in a heavy sea. The locality was between Honolulu and San Francisco, but nearer to the former."

DESCRIPTION OF A NEW SPECIES OF SEBASTODES.

BY CARL H. AND ROSA S. EIGENMANN.

Sebastodes serranoides.

Sebastichthys flavidus E. & E. Notes from San Diego Biol. Lab. i, 5, 1889. (Cortes Banks.)

Types: No. 993, one specimen .24 m., Cortes Banks.
No. 402, one specimen .47 m., San Francisco.
No. 403, one specimen .36 m., San Francisco.
No. 404. one specimen .36 m., San Francisco.
Three specimens .38–.49 m., San Francisco.

On May 16, 1890, we collected a large number of specimens of *Sebastodes*. Among these were specimens of what we previously supposed to be *S. flavidus*. There were also other specimens identifiable with current descriptions of *S. flavidus* which were however quite different from the others. The deeper ones with an elevated spinous dorsal and deep notch between the dorsals are evidently to be referred to the species figured by Ayres* as *S. flavidus*. The others represent an apparently undescribed species. It is frequently brought into the San Diego market, while *S. flavidus* is rare at that point. In general shape and color it greatly resembles *Serranus clathratus*, from which it is not distinguished by the fishermen.

Head 3; depth $3\frac{1}{3}$–$3\frac{1}{2}$; D. xiii, 15–16; A. iii, 9. Lat. l. 60 (pores).

Elongate slender, the dorsal profile but little more arched than the ventral. Head compressed, the anterior profile almost straight. Snout long, pointed; the lower jaw projecting, its tip entering the profile.

Cranial ridges less developed than in any other species,

* Proc. Cal Acad. Nat. Sci. ii, 219, fig. 64, 1862.

none of them ending in spines. Nasal spines minute, not evident externally. Parietals meeting above. Preorbital without spines. Preopercular spines long, slender, the lower ones as well developed as the middle ones in the largest specimens. Opercular spines as in *flavidus*. Gill-rakers long and slender, as in *flavidus*.

Scales large, those of the head greatly reduced. Snout, mandibles and even the lips closely scaled in the old.

Palatine patches of teeth peculiar, a constriction near their middle, the anterior angle turned inward.

Eye large, $4\frac{1}{2}$ in the head, $1\frac{1}{3}$ in snout, $1\frac{1}{4}$ in the strongly convex interorbital.

Dorsal fin low, the highest spine about 3 in the head, notch between the two fins deep. Caudal notched. Anal spines slender, graduated. Pectorals not reaching tips of ventrals, not nearly to vent.

Gray of varying shades, the back always darker; a series of large white blotches along the sides of the back much more marked in some examples than in others. Fins all more or less strongly tinged with yellow and edged with dusky.

From *S. flavidus* and *S. melanops* and *S. goodei* this species may be distinguished by the characters taken from fresh specimens of like size, as follows:

a. Color dusky; no red.

b. Snout acuminate, the lower jaw strongly projecting, entering the profile. Anal truncate or subtruncate.

c. Eye large, 1 in snout, 1 in interorbital, 4 in head. Tips of nasal spines free. Occipital ridges well developed. Highest dorsal spine $2\frac{2}{5}$–$2\frac{3}{5}$ in head. Palatine band of teeth of nearly uniform width. Olivaceous, yellowish on sides, lighter below. Sides with rusty spots usually near the tips of scales. Base of spinous dorsal sometimes spotted. Second dorsal, caudal and anal bright orange, margined with black. An orange streak down and back from eye, a broader one back from eye, a narrow one on maxillary. Pectorals and ventrals orange or brassy, blackish tipped. Head 3; depth about 3; D. xiii, $14\frac{1}{2}$; A. iii, $8\frac{1}{2}$. *flavidus*, *cc*. Eye conspicuously smaller, 1 1/3 in snout, 1 1/4–1 1/8 in interorbital, 4 1/2 in head. Tips of nasal spines concealed.* Occipital ridges low. Highest dorsal spine 2 4/5–3 in the head. Band of palatine teeth usually much narrower at the middle than at the ends. Gray, darker above, with a series of large light spots on the back. Fins colored like the body, the second dorsal, the caudal and anal yellowish. Head 3; depth 3 1/3–3 1/2. D. xiii, 15 1/2; A. iii, 9 1/2. *serranoides.*

bb. Snout blunt, lower jaw scarcely projecting. Anal rounded. Eye slightly more than 4 in the head. Highest dorsal spine 2 1/2–3 in head. Pectorals rounded, not reaching tips of ventrals. Dark gray, with small darker spots. Black spots on base of spinous dorsal. Head 3; depth 3–3 1/5; D. xiii, 13 1/2; A. iii, 7 1/2–8 1/2. *melanops.*

aa. Bright vermillion, lighter below. *goodei.*

*Evident on one side of one of the types.

S. goodei is not an uncommon fish in the market at San Francisco where specimens 23 inches long were observed.

Sebastodes levis has also been observed in the San Francisco market, having been brought from Monterey.

CITHARICHTHYS SORDIDUS. — We have recently procured a large number of *Citharichthys stigmæus* and also the young of *C. sordidus*. The material obtained proves the validity of both species.

ERUPTIVE ROCKS FROM MONTANA.

BY W. LINDGREN, U. S. GEOL. SURVEY.

During the summer of 1883, while engaged in the geological survey of the lands adjacent to the Northern Pacific Railroad (The Northern Transcontinental Survey) under the direction of Mr. R. Pumpelly, I visited many parts of the Rocky Mountains in Montana, as a member of the reconnoitering party of Mr. W. M. Davis. I chiefly directed my observations to the occurrence and character of the eruptive rocks, and during the following winter examined a number of them microscopically. The results of this examination were subsequently published by Mr. Pumpelly in Vol. xv, 10th Census, p. 719, together with other investigations of the Northern Transcontinental Survey.

Hoping to secure new points of view and perhaps corrections in the old determinations I have recently reviewed the evidence and the conclusions to which I had arrived, and the results of this review are embodied in this paper. Occasional changes in the nomenclature of the rocks described have been made and especially the analcite basalts subjected to a detailed re-examination.

INTRODUCTION.

The effusive volcanic rocks of later tertiary and recent date are conspicuously absent in the Belt Mountains or Front Ranges as well as in the Main Range of the Rocky Mountains in Montana. Eruptive rocks are, however, not wanting; indeed they form a prominent part of the geological structure of the region mentioned. They do not appear as lava flows, as subaerial eruptions, but as intrusive bodies forming dikes, necks, sheets or laccolites enclosed in sedimentary rocks. It is not to be doubted that in many cases these eruptions have also furnished large amounts of effusive masses, but these subaerial flows have long ago been eroded, leaving exposed the vents and fissures through which they once poured forth. In continuing its action the erosion has produced a peculiar type of mountains, of which the Highwood and the Crazy Mountains are good examples. Both are isolated volcanic districts and consist of an intricate network of dikes and necks, intruded in sandstones and shales of Cretaceous or Laramie age. The erosion removes the softer sedimentary strata much more rapidly than the eruptive rocks and the adjoining, slightly metamorphosed sandstones. The result is an isolated group of mountains with extremely rugged and serrated crests and ridges, rising abruptly several thousand feet above the surrounding hilly or undulating country.

A great deal of interest is attached to these volcanic masses. They expose to examination intra-telluric rocks, consolidated under conditions greatly differing from those to which the subaerial flows were subjected; having at any rate cooled very slowly and under very considerable pressure. The structure of the rocks is most generally holocrystalline-porphyritic. Glass basis is not frequent, but may be noticed in a few instances. A certain number of rocks have a holocrystalline-granular structure in many cases connected with the porphyritic by transitions. In a few cases the rocks are very coarse granular and this occurs both in basic (Theralites, Wolff) and acid members of the series.

As to chemical composition these rocks appear to be more varied than the series usually found in the Great Basin; magmas rich in potassium are frequent, crystallizing as trachytes; often they are very basic and contain much sodium, resulting in the abundant separation of such minerals as nepheline, sodalite and analcite.

It is not easy or even possible in a great many cases to establish the exact age of these eruptives; this is largely owing to the fact that no rocks of later age than Laramie, the disputed territory between the Cretaceous and the Tertiary, occur in the region referred to. The volcanics are intrusive in sedimentary rocks of very different age, from Cambrian to Laramie; nearly all of the types may, however, be found in Cretaceous or Laramie strata, and the evidence tends to show that the eruptions, beginning towards the close of the Cretaceous period, continued during part of the Tertiary. During the later part of the Tertiary and Quaternary the eruptions must have subsided in Northern and Central Montana, although further southward they still continued with undiminished force.

The character of the subaerial masses accompanying these eruptions is not well known; only a few conglomerates in the Laramie give some hints as to their nature. In the case of a volcanic conglomerate at the coal fields of Bozeman the horizon could be determined to be 2200′ above strata in which fossils of the Fort Benton group were found; this conglomerate consists of pebbles of hornblende-andesites to which consequently no later age than Lower Laramie can be assigned.

In a conglomerate in the Highwood Mts. (Laramie or Upper Cretaceous) dacites and andesites with brown, black-bordered hornblende and cryptocrystalline groundmass are noticed. At Sixteen-Mile Creek (Belt Mts.) augiteandesite with glassy microlitic groundmass is found in a conglomerate, interbedded with Laramie strata.*

The nomenclature of this Cretaceo-tertiary series of intrusives offers a great many difficulties. I have in this paper used the names of the tertiary effusive rocks for the different porphyritic members of the series, and, for

*10th Census, vol. xv, p. 736,

the granular rocks of the same age, the names of diorite, syenite, etc. The latter have been employed simply as structural and mineralogical terms, and not as implying any certain age.

Among the dacites and hornblende andesites are found many which, by other writers, doubtless would have been classed as porphyrites on account of their intrusive occurrence and holocrystalline structure.

A brief reference should be made to the few igneous rocks in the district examined, which are not with any certainty connected with this later Cretaceo-tertiary series. Well exposed at Mullan Pass and between there and Helena is an area of hornblende biotite granite which at its contact metamorphoses the adjoining carboniferous limestones; it is rich in plagioclase and may in places rather be considered as a quartz mica diorite. The series exposed at Mullan Pass extends from the Carboniferous to the Cretaceous, and the possibility is not excluded, indeed, that the granite is of very late Mesozoic age.

Similar intrusive masses appear in the Big Belt Mountains and, connected with them, dikes of quartz-porphyrite in the Cambrian slates.

Dikes of diabase have been observed in the red Cambrian or Silurian slates at several places and only in these strata. It is partly a normal diabase, partly a quartz diabase, the quartz being connected with the feldspar in granophyric structure.*

I. Dacites, Hornblende-Andesites, Diorites.

In the Little Belt Mountains and at various points in front of the Main Range, west of Fort Benton, are found light-colored, mostly porphyritic, more or less acid rocks, principally composed of hornblende, feldspar (usually

*10th Census, vol. xv, p. 735.

plagioclase with a varying amount of orthoclase) and sometimes quartz. There may be two generations of quartz and feldspar but only one early generation of hornblende. These rocks, although varying much in structure and composition, apparently form a natural group and occur in the Little Belt Mountains as large intrusive masses — evidently laccolites — in Carboniferous and Jurassic strata; along Dearborn Creek on the east side of the Main Range on the trail to Cadottes' Pass, rocks indistinguishable from the former occur as dikes in Cretaceous or Laramie sandstones. The eruptives from both these localities are indeed so similar that they may be described together.

The most prevalent habit is porphyritic, but there also appears to be a continuous series of transition from porphyritic to fine granular hyphidiomorphic rocks. The color of the rocks is usually yellowish or yellowish gray; in a groundmass of fine-grained structure are imbedded phenocrysts of a glassy, fresh feldspar, smaller, well defined, usually rectangular feldspar crystals of a yellowish color and small quartz grains, sparingly distributed; biotite foils occur in some specimens, but universally present are prisms of green hornblende, not more than 2–3 mm. in length.

Under the microscope the rocks of this class present the following characteristics: Larger, not striated feldspar phenocrysts of sometimes irregular outlines; this is, according to extinctions obtained from cleavage fragments, orthoclase, and is present in varying quantities. There is indeed reason to believe that these rocks by gradual transition go over into trachytic and rhyolitic forms. Usually much more abundant are square or rectangular sections of a triclinic soda-lime-feldspar which, according to the extinctions of the twin lamellæ should be referred to andesine or labradorite. Quartz is sometimes present in rounded and corroded grains, occasionally with sharp crystallographic outlines; it contains inclusions of fluid gas and probably also of glass. Straight, brown biotite foils and greenish brown hornblende in well-defined long prisms of the usual section, often twinned and partly converted into chloritic products, close the list of porphyritic minerals. As accessories occur constantly zircon, apatite, titanite and sometimes malacolite in small greenish prisms.

The groundmass is always holocrystalline, but may have several structural forms: 1. Allotriomorphic microcrystalline, consisting of quartz and usually unstriated feldspar. 2, Microcrystalline, with a structure somewhat related to the granophyric; each quartz grain contains many smaller feldspar grains with irregular orientation. Both these structural forms may occur together in the same specimen. In quite a number of specimens this structure is prominent. 3. Lathlike-granular, composed of lathlike plagioclase crystals, between which lie irregular grains of quartz and unstriated feldspar. From this latter form of hornblende-andesites, in which quartz and orthoclase are not present as phenocrysts, there is but a short step to a fine grained hyphidiomorphic granular hornblende plagioclase rock; if only one generation of lathlike or prismatic plagioclase crystals is developed the rock will be hyphidiomorphic granular and a diorite. Both at Dearborn Creek and in the Little Belt Mountains, such granular rocks are represented and appear in so close connection with the normal porphyritic forms that their geological equivalence cannot be doubted. These diorites, apparently analogous to those which Stelzner has called "Andendiorite" are usually fine to medium grained rocks in which hornblende needles and feldspar prisms may be discovered with the naked eye. Microscopically, they consist of idiomorphic biotite and hornblende with abundant, lathlike, triclinic feldspar, some irregular grains of the same and of monoclinic feldspar; the interstices between the latter are filled with quartz in smaller or larger quantities.*

II. Augite Syenites.

This small but interesting group is at present limited to three occurrences, all in the form of dikes.

1. In Silurian quartzites of Belt Creek, Little Belt Mountains.

2. In Jurassic (?) strata at the stage station near Dry Fork, road from Barker to Fort Benton, Little Belt Mountains.

3. In Cretaceous or Laramie strata at road, north side of Main Pass, Highwood Mountains.

Mineralogically the augite syenites consist principally of orthoclase, plagioclase, biotite and a pyroxene, probably malacolite. As to structure they are hyphidiomorphic granular.

The first contains small prisms of light green malacolite and small, sometimes hexagonal biotite foils imbedded in a coarser allotriomorphic granular mass of feldspar, apparently orthoclase, sometimes twinned according to the Carlsbad law, but more frequently in single grains. The interstices between the grains are sometimes filled with quartz.

The second is a fine grained, light colored rock, in which without lens may be seen black biotite foils and lathlike feldspar crystals. Under the microscope straight long biotite foils and slender apatite prisms appear as products of

*Similar rocks have also been described by Mr. E. Wolff in "Notes on the Geology of the Crazy Mountains," Northern Transcontinental Survey, 1885.

first consolidation; the greenish augite is allotriomorphic and partly later than the plagioclase; associated with it and surrounding it is a dark green hornblende in small quantities. The principal mass consists of allotriomorphic or lathlike feldspar crystals; some prisms are plagioclase with very narrow striation; orthoclase occurs in Carlsbad twins but predominating is an intimate microperthitic mixture of orthoclase and plagioclase (albite?). The interstices between the lathlike feldspars, mostly triangular spaces, are often filled with a colorless isotropic substance which sometimes also fills the interior of the feldspars in a curious manner. Faintly double refracting spots may occasionally be noticed in the isotropic mass. This interstitial mass has every appearance of glass, but it might also be a tesseral mineral, perhaps related to sodalite. It dissolves easily in hydrochloric acid and gives a strong Na reaction. The rock contains 5.50% Ka_2O and 4.14% Na_2O, according to determinations made by Mr. E. Whitfield. This rock is described on p. 723 in Vol. xv, 10th Census, and is there called a mica-augite trachyte.

The third, from the Highwood Mountains, is a light colored coarse-granular rock in which larger feldspar crystals and small green augites may be noticed with the naked eye. Under the microscope: Partly idiomorphic green augite and irregular foils of biotite, both rather sparingly; the principal mass consists of feldspar in large thick prisms, not striated but often intergrown in microperthitic form with an exceedingly closely striated plagioclase. Between these prisms lies an allotriomorphic mass of large, irregular and interlocking grains, mostly microperthite. A partial analysis of the rock by Dr. F. A. Gooch gave Ka_2O: 5.66%, Na_2O: 7.88, which would seem to indicate that the plagioclase is albite or oligoclase. This rock was described in the paper mentioned as a "crystalline augite-trachyte."

There is every reason to believe that these three dikes are of the same age, presumably very late Cretaceous or Post-cretaceous. At the two first-mentioned places the rocks occur more isolated, while in the Highwood Mounttains the augite syenite is surrounded by a great number of trachytic and basaltic dikes, also intrusive in the Cretaceous or Laramie strata and which cannot be much, if any, younger than the former; in fact, a dike of the same character as the augite syenite just described was noticed by Mr. W. M. Davis cutting another dark green dike belonging to the later to be described basaltic group.

III. Trachytes.

That normal porphyritic trachytic rocks of great variety of appearance are abundantly represented in the Highwood Mountains has been shown in my paper, frequently referred to elsewhere. The ferro-magnesian silicates, accompanying the sanidine, are augite and biotite. While the latter usually is present, it mostly appears in smaller quantities and is less conspicuous. The augite on the other hand is always present and often very prominent; the dark green, octagonal, long and slender prisms, with terminal P.OP are under the microscope of a more or less intense green color, often somewhat pleochroitic and evidently contain an admixture of the ægirine molecule. This very characteristic augite is a seldom failing constituent not only of the trachytes but also of the later to be described basaltic dike rocks of Northern Montana.

In this series of augite trachytes the relative quantities of the two minerals—augite and orthoclase (sanidine)—varies very much. At one end of the series stands a rock composed nearly entirely of feldspar; at the other end a dark basaltic rock with porphyritic augites and a sanidine augite groundmass. The association of sanidine with large amounts of augite is certainly a very rare occurrence, although not altogether unknown. (Ponzatypus, Rosenbusch, Micr. Phys. der Mass. Gest., p. 597.)

It is true that these rocks do not appear as extravasated masses, but as dikes; among them and associated with them are many holocrystalline and granular rocks; but among them are also glassy rocks and rocks with normal trachytic structure; and I feel confident that the name of *trachyte* applied to them is more proper and suitable than that of *orthoclase porphyry*.

It should be borne in mind that these trachytes, with their great difference in structure and composition, all occur within a quite limited district and that the pressure under which they consolidated must have been practically the same; the rate of cooling, however, might have been very different for the earlier and the later intrusions in the same volcano, as Mr. Iddings and others have recently pointed out.

In the following pages a few of the different types will be briefly described.

a. Chiefly consisting of sanidine. This type is only represented by a 50′ wide dike cutting cretaceous shales in the southern foothills a little west of the road across the mountains to Fort Benton. A yellowish gray rock, somewhat porous and rough. Contains large thick tabular phenocrysts of sanidine, 1 to 2 m. long, yellowish and cracked. An alkali determination of the rock, made by Dr. F. Gooch, gave Ka_2O: 11.82 %, Na_2O: 2.5%. *Thin section:* Large, normal sanidine crystals in a trachytic groundmass of feldspar microlites; much limonite; isolated biotite foils. The rock, when fresh, probably contained more ferro-magnesian silicates.

b. Porphyritic augite and sanidine; groundmass augite and sanidine. No. 40 of the original collection represents this type well. The rock shows a greenish-gray groundmass in which are imbedded light flesh-colored feldspar crystals of a tabular habit, 2–3 mm. long and about 1 m. thick. *Thin section:* Clear, typical sanidine crystals of normal form and often appearing as Carlsbad twins; the rough separation parallel to $\infty P\bar{\infty}$ is often seen; contains as inclusions round or hexagonal crystals, isotropic and possibly related to the sodalite group; this mineral dissolves readily in HCl and gives abundant crystals of NaCl. Sparingly occur brown foils of apparently uniaxial biotite. Large prisms of a deep green, pleochroitic pyroxene with nearly colorless center. The axis of elasticity, in the green shell, lying next to c is $\mathfrak{c}$, not $\mathfrak{a}$, as should be the the case if the mineral were ægirine, and the angle $c \overset{\wedge}{-} \mathfrak{c}$ is 30° in the same direction as the corresponding angle of the colorless center, that being nearly normal for augite or 38°. The pleochroismus is $\mathfrak{c}$ leek-green, $\mathfrak{b}$ and $\mathfrak{a}$ more yellowish-green. From this it would appear that an augite with admixture of the ægirine-molecule is present.

The groundmass consists of needles of the same deep green pyroxene, together with microlites of feldspar and possibly some glass.

This type may also be developed much more crystalline, as for example, in a heavy dike cutting the road to Fort Benton a few miles north of the divide. It is a greenish gray fine-grained rock, porphyritic by a great number of thin tabular white sanidine crystals (maximum size 5 mm. x 10 mm. x 1 mm.) arranged parallel to the walls of the dike; also containing augite prisms of the usual habit and color, up to 3 mm. long. The groundmass contains augite, feldspar, and small biotite foils. The sanidine crystals were partly analyzed by Dr. F. A. Gooch, who obtained:

Ka_2O: 11.36%, Na_2O: 2.14%. *Thin section:* The phenocrysts mentioned above are imbedded in a holocrystalline groundmass, composed of sanidine crystals of varying size, augite prisms and small foils of biotite. No plagioclase noted: there is in fact, a gradual transition from the phenocrysts down to the smallest individuals. Possibly some glass between the crystals of the groundmass. Apatite in clear, short prisms.

In a series of dike rocks, closely allied to the one just described, the augite gradually increases in quantity. In a specimen from the southern slope, for instance, the sanidines are much smaller and thinner; there is at least as much augite as sanidine; the groundmass still contains sanidine predominantly, usually in form of short prisms with extinctions ranging from 0° up to 5°. Besides there are a few plagioclase-microlites.

c. Finally the porphyritic sanidine disappears and the augite in dark green, long prisms takes its place; the groundmass is dark gray or dark green; these rocks form the third type. No. 35 shows in thin-section large porphyritic augites of prismatic habit and light green color, together with some partly idiomorphic olivine crystals imbedded in a clear groundmass consisting of grains and microlites of feldspar, cemented by colorless glass. The feldspars when showing crystalline form have a short prismatic habit and are not striated, but sometimes form Carlsbad twins; the glass is colorless and easily dissolves in HCl. In this class of rocks the feldspars should be more investigated, by chemical analysis and by separations.

IV. Plagioclase Basalt.

There are a few rocks among the dikes of the Highwood Mountains which might be classed as plagioclase basalts. West of Fort Benton, however, they are much more frequent and were noticed to be especially well developed in the Sun River district and in the Birdtail Mountains. They occur as large dikes or necks, probably also as intruded sheets and are wonderfully well exposed by erosion.

The basalt from Highwood Mountains is a dark green fine-grained rock, in which dark green pyroxenes and brown specks of olivine are visible with the naked eye.

Thin section: Idimorphic augite, light green and containing many glass inclusions; olivines, sharp-edged and decomposed; no porphyritic feldspar; groundmass hyalopilitic with long feldspar needles, seldom striated and extinguishing about parallel to their longer axis; contains also small, irregular grains of augite.

The basalts from Sun River and the Birdtail Mountains are characterized by the same long prismatic augite of a lighter or darker green color which is found in the Highwood dike rocks. Olivine is not always present. The groundmass is usually clearly basaltic, often holocrystalline and quite coarse. In a rock from Table Mountain near Sun River, I thought that the presence of leucite was probable. Re-examination of the slide does not seem to confirm this.

V. Analcite-Basalts.

The most interesting group of the rocks from the Highwood Mountains is doubtless that which is described in the paper in Vol. xv, 10th Census, as Analcite (Nosean) Basalts. They occur as dikes of varying dimensions in the Cretaceous or Laramie sandstones of the Highwoods, probably also as volcanic necks, together with augite syenites, trachytes and plagioclase basalts; mineralogically they consist of augite, olivine, magnetite, and a mineral determined as analcite; biotite is sometimes present in small quantity; feldspar, nepheline and leucite are absent.

Although the examination seemed to indicate that the analcite was primary, I hardly felt myself warranted, with the evidence in possession, to make an assertion so opposed to the dogmas of petrography, and upon finding that some of the rocks contained a trace of sulphuric acid expressed a surmise that the mineral in question might have been derived from noseane or a related mineral of the sodalite group,—at the same time, however, mentioning the remarkably primary appearance of the analcite.

After a thorough re-examination of the slides and the rocks with such scanty material as remained to me, this view no longer seems tenable, and I think the probability very great that the mineral is primary analcite, or possibly a primary mineral very closely related to analcite.

It does not, indeed, seem impossible to obtain a hydrous silicate from a magma in aqueous fusion, provided the process of solidification were carried on slowly and under sufficient pressure. That hydrous substances can solidify from a molten magma is already proved by the undoubtedly primary water, which is so often found in old and recent volcanic glasses. Moreover, analcite is a mineral which may be formed and exist under high pressure and quite high temperature, as shown by Friedel and Sarasin, who produced artificial crystals of analcite at a temperature of 400° and high pressure.*

The typical analcite basalts are dark green rocks, porphyritic by dark green long augite prisms and abundant small round crystals of a whitish color. Occasionally the olivine is also visible. In thin section the augite appears as long octagonal prisms with good cleavage and normal extinction; the color is light green in transmitted light, usually darker green toward the periphery, or the crystals

*Sur la reproduction de l'albite par voie aqueuse. C.R. 1883, xciii, 5, p. 290.

show zonar structure, indicated by color or inclusions of gas or groundmass. Twins (twinning plane $\infty P \bar{\infty}$) are quite frequent. This augite is identical with the variety occurring in the trachytes and described previously.

The olivine is usually sharp-edged, clear and fresh, sometimes surrounded by a narrow border of biotite; when decomposing a yellowish brown ferruginous serpentine results. A mineral of the spinell group is observed as inclusion in the olivine. Magnetite is abundant and often enclosed in the augite.

The order of solidification has evidently been magnetite, olivine, augite, the first being the oldest. Later than the augite is the mineral determined as analcite. Together with the other porphyritic crystals it is imbedded in the groundmass and appears as hexagonal, seldom octagonal, most frequently simply rounded sections. In size they do not exceed one millimeter but are frequently much smaller. Most of the crystals are perfectly isotropic but not quite clear, being somewhat clouded by minute interpositions which under large magnifying power prove to be largely gas, in part also glass inclusions. The former have often a very irregular form. Irregular spots showing a faint double refraction are sometimes noted, more so in some sections than in others. Under favorable circumstances an imperfect cleavage in two directions, crossing each other perpendicularly, may also be noticed. Minute fragments from an exceptionally large crystal melt rather easily and quietly before the blowpipe to a white enamel. In one thin section a large crystal showing irregular octagonal form with very distinct cleavage was selected for experiment. It was uncommonly clear and perfectly isotropic. Hydrochloric acid dissolves it easily upon very slight heating under abundant formation of chloride of sodium. Ignition does not make it opaque and does not produce double refraction. No microscopic reaction on Cl or SO_3 could be obtained.

A quantity of this isotropic mineral had been previously isolated and analyzed (No. 1) giving almost exactly the composition and specific gravity of analcite. In order to test the accuracy of this analysis a piece of the same rock was again subjected to a separation by the Thoulet solution. The powder obtained was pure and with few exceptions composed of perfectly isotropic grains. The result of this second analysis (No. 2) which Dr. W. H. Melville of the U. S. Geol. Survey had the kindness to make for me, is given below. The total substance for this analysis only amounted to 0.3576 grm.; to bases and silica 0.2526 grm. was used, in which sulphur and chlorine were looked for quantitatively, thus increasing the ordinary errors of the separation of bases and silica. For water and alkalies 0.1050 grm. was used.

	No. 1.	No. 2.
SiO_2	54.90%	49.87%
Al_2O_3	23.30	22.55
Fe_2O_3	trace	1.51
CaO	1.90	2.62
MgO	0.70	1.28
Na_2O	10.40	10.92
Ka_2O	1.60	2.66
H_2O	7.50	11.05
	100.30	102.46
	Sp. gravity: 2.20	Sp. gravity: 2.24
	No chlorine.	Trace of chlorine.
	No sulphur.	No sulphur.

The oxygen ratio of this last analysis is nearly $\dot{R}:\dddot{R}_2:\ddot{Si}:\dot{H}_2 = 1:3:7:2$ whereas that of analcite would be

1:3:8:2. Considering, however, the exceedingly small quantity of substance used for this analysis, the result evdently points more closely to analcite than to any other other mineral.

The first question in the interpretation of this mineral is naturally: Are not the crystals isolated and analyzed secondary products? It does not seem possible to me to regard them as such: the rock is often fresh and shows no trace of decomposition: even the olivines are usually clear and unattacked; the crystals are homogeneous and isotropic, the cleavage is often distinct. Nepheline could of course not be the mineral from which the analcite might be derived; the form of the crystals prohibits that supposition. Very little choice then remains; sodalite, haüyne nosean or leucite are the only possible minerals. A decomposition of either of these to analcite could of course take place, but that it could have occurred and left the rock in such a fresh condition, making each crystal a separate individual of analcite seems exceedingly improbable. Besides, the form of the crystal and the lack of inclusions of augite crystals militate strongly against the supposition that leucite could have been the primary mineral.

The absence of chlorine and sulphur, except sometimes in traces, in the isolated mineral, speaks equally strongly against sodalite, noseane and haüyne.

The groundmass in these rocks, as in that section for example, represented in fig. 1, consists of small, dark green prisms and irregular grains of augite, a second generation of small analcite crystals and magnetite. There is probably no glass present, though if it were it would be difficult to distinguish it from the isotropic analcite. The larger augite crystals are sometimes surrounded by a ring of smaller analcites.

Fig. 1. Analcite Basalt, magnified 25 Diameters.
A. Olivine. B. Augite. C. Analcite.
Groundmass: augite, analcite, magnetite, apatite.

In some specimens faintly double-refracting spots are more frequent in the analcite crystals. I do not feel positive whether this is a result of a physical or a chemical change in the isotropic substance. In the original paper in Vol. xv, 10th Census, these phenomena were regarded as results of the anomalous double refraction so often observed in the analcite (more frequently, though, in free crystals, than in the mineral when enclosed in the rock mass).

In some specimens of the rock in question, the larger part of the colorless mineral is faintly double-refracting, showing bluish gray colors, between crossed nicols; the crystals are then not so well defined, and often take the form of rounded spots separated by groundmass and small porphyritic augites and olivines; these rounded spots, between crossed nicols, divide into irregular, sometimes also into regular triangular fields. I regarded this (see Vol.

xv, 10th Census) as double-refracting analcite. When isolated, it has the specific gravity of analcite, and, according to an analysis of impure material, a similar composition, although the percentage of silica is too low. No chlorine or sulphur. Sp. gravity: 2.24.

It should be noticed that the rocks in which this variety occurs are perfectly fresh, even more so than those containing the isotropic mineral; the olivine and the augite show no trace of decomposition.

In the analcite basalts, as described here, there is no evidence of decomposition, except that the olivine is occasionally converted to yellowish-brown serpentine. In other specimens, however, it is seen that the analcite offers but slight resistance to decomposition; needles of a zeolite with vivid colors of interference, probably stilbite, penetrate the analcite in all directions and soon every crystal is transformed to an aggregate of zeolites. Large stilbite crystals are found in the decomposing rock. The augite is much more resistant and frequently remains intact when all the other constituents have been entirely decomposed.

CUCURBITACEARUM NOVUM GENUS ET SPECIES.

AUCTORE
A. COGNIAUX.

BRANDEGEA gen. nov.

Flores monoici. Masculi racemosi. Calycis tubus pateriformis; dentes 5, subulati, brevissimi. Corolla rotata, usque ad basim 5-partita, segmentis ovato-triangularibus, acutis. Stamina 3, filamentis in columnam centralem coalitis; antheræ subliberæ, loculis longitudinaliter replicatis. Pollen læve, humefactum globosum, trisulcatum. Pistillodium nullum.—Flores feminei in eadem axilla cum masculis solitarii. Calyx et corolla maris. Staminodia nulla. Ovarium oblique obovoideo-oblongum, longe rostratum, uniloculare; stylus brevissimus, stigmate hemisphærico; ovulum unicum, erectum. Fructus oblique anguste obovoideus, siccus, indehiscens, lævis vel sparse echinatus, 1-spermus, pericarpio tenuis. Semen anguste trianguluri-obovatum, argentatum, apice subtruncatum vel interdum bicornutum, testa crustacea tenuissime verruculosa.

Herbæ scandentes, glabræ, gracillimæ, radice ut videtur perennante. Folia petiolata; profunde 3–5-partita, supra albo-punctata et scabra. Cirrhi capillares, simplices. Flores albescentes, masculi minutissimi, feminei paulo majores. Fructus minutus.—Affin. gen. *Cyclanthera* Schrad.

B. Bigelovii; foliis mediocribus, breviuscule petiolatis; racemis masculis apice 3–9-floris; floribus femineis longe pedunculatis; fructu lævi, rostro quam fructu multo longiore.—*Melothria pendula* Brew. et Wats. Bot. Cal. I, 240, excl. caract. (non Linn.).—*Elaterium Bigelovii* Wats. in Proc. Amer. Acad. xii, 252.—*Echinocystis (?) Bigelovii* Cogn. in DC. Monogr. Phan. iii, 804.

Ad Soledad.— Etiam in valle flum. Colorado (Bigelow et Palmer),

B. MONOSPERMA; foliis parvis, brevissime petiolatis; racemis masculis usque ad medium 15–20-floris; floribus femineis breviter pedunculatis; fructu adpresse sparseque echinato, rostro quam fructu subbreviore.— *Cyclanthera monosperma* Brandegee in Proc. Cal. Acad., ser. 2, ii. 159.

In California inferiore ad Agua Dulce et Las Huevitas.

ECHINOCYSTIS: Sect. IV, PSEUDO-ECHINOPEPON.

Radix fibrosa. Flores 5-meri. Fructus siccus, mature ut videtur bivalvis, multilocellatus, locello centrali 1-spermo rarissime 2-spermo, cæteris vacuis. Semen parvum, complanatum, creberrime minuteque granulosum.

E. BRANDEGEI; foliis parvis, ambitu suborbicularibus, utrinque brevissime denseque hirtellis, usque ultra medium 5-lobatis; cirrhis bifidis vel superioribus simplicibus; paniculis parvis, paulo ramosis, plurifloris; calyce puberulo, pateriformi; fructu satis parvo, sphærico, dense echinato, abrupte longeque rostrato, rostro caduco.

Caulis humifusus, circiter 7 m. longus, ramis gracilibus, leviter puberulis, profunde sulcatis. Petiolus gracilis, striatus, dense puberulus, 1½–3 cm. longus. Folia rigidiuscula, pallide viridia, 2–4 cm. longa lataque, lobis anguste obovatis, basi satis constrictis, apice subrotundatis apiculatisque, margine undulato-denticulatis; sinus inter lobos obtusissimi, basilaris rotundatus, ½–1 cm. profundus. Cirrhi graciles, elongati, striati, leviter puberuli. Pedunculus communis masculus gracilis, sulcatus, brevissime hirtellus, 1½–5 cm. longus; pedicelli capillares, 1–3 mm. longi. Calyx 2 mm. latus, minute denticulatus. Corolla albescens, furfuraceo-puberula, segmentis patulis, triangulari-oblongis, acutis, 2–2½ mm. longis. Columna staminea brevissima; capitulum antherarum depressum, ½ mm. latum, loculis flexuosis. Flores feminei solitarii, brevissime graciliterque pedicellati. Fructus fuscescens, glaber, 1½ cm. crassus, rostro angusto, 6–8 mm. longo; aculei robusti, rigidi, 3–4 mm. longi. Semen cinereo-fulvum, obovato-oblongum, basi attenuatum, 1 cm. longum, ½ cm. latum, 1½–2 mm. crassum.

In California inferiore ad Todos Santos.

NOTES ON THE SUBALPINE MOLLUSCA OF THE SIERRA NEVADA, NEAR LAT. 38°.

[With Plate I.]

BY W. J. RAYMOND.

CATALOGUE OF SPECIES, WITH ALTITUDES OF CHIEF LOCALITIES.

	Species.	West Slope of Sierra Nevada.							East Slope.		
		3000 ft. 12 m. east of Columbia.	3750 ft., Hetch-Hetchy Valley.	4000 ft., Yosemite Valley.	4500 ft., Reed's River.	4800 ft., Lake Eleanor.	5300 ft., Hull Creek.	8000 ft., 9000 ft. Tuol'e Meadows.	9700 ft., Head of Cañon.	8000 ft., Bloody Cañon.	6750 ft., Near Mono Lake.
1	Vitrina pfeifferi *Newcomb*			*	*					*	
2	Hyalina arborea *Say* (+breweri *Newc.*)			*		*					
3	Conulus fulvus *Draparnaud*				*					*	
4	Patula striatella *Anthony*					*				*	
5	Microphysa pygmæa *Draparnaud*					*				*	
6	Campylæa mormonum *Pfeiffer*				*	*					
7	Vallonia pulchella *Müll.* (var. costata)									*	
8	Pupa corpulenta *Morse*									*	
9	Pupa (Vertigo) ovata *Say*?					*					
10	Succinea stretchiana *Bland*			*		*				*	
11	Physa gabbi *Tryon* (var.)					*					
12	Physa blandi *Lea*	*								*	
13	Planorbis *var.* disjectus *J. G. Cooper*		*	*		*		*			
14	Gyraulus vermicularis *Gould*					*					*
15	Gyraulus parvus *Say*									*	
16	var. elevatus *C. B. Adams*					*					
17	Ancylus *var.* subalpinus *J. G. Cooper*			*						*	
18	Sphærium raymondi *J. G. Cooper*		*					*			
19	Pisidium abditum *Prime*				*	*	*				
20	Pisidium occidentale *Newcomb*							*	*	*	
21	Pisidium compressum *Prime*							*			
22	Limax campestris *Binney* (var.?)			*							

The shells mentioned in these notes were collected between June 22d and August 4th, 1889, while making a vacation trip on foot across the Sierra Nevada, from Columbia through the Hetch-Hetchy and the Yosemite valleys, to Tuolumne Meadows and Mono Lake. It must be stated that the ground traversed was not all carefully searched for shells, the main objects of the trip being recreation and a sight of the sublime scenery of the high Sierra. Collections were made only as the accomplishment of these objects permitted.

The altitudes given by me were mainly determined with a small aneroid barometer, and unless given with exactness must be considered as only approximate, those most accurate being from Whitney's Geological Survey.

The route across the mountains ran nearly east, and within 18 miles of latitude 38°, which parallel passes close to Lake Eleanor and through Mono Lake. The summit of Mono Pass is 10,765 feet altitude, but the chief collections were made near the two lakes mentioned, on the opposite slopes, as shown by the table. The following list describes more fully the localities and conditions in which each species was found, with other facts of interest:

1. Vitrina pfeifferi Newcomb. This species, first described from the east slope of the Sierra, occurs at high elevations, or from 4,000 to 8,000 feet in this latitude, and south to Fresno County; also from 7,500 to 10,800 feet in the Rocky Mountains, and toward the north comes down to the sea level in Alaska. I found it in 1885 near Quincy, Plumas County, at about 3,400 feet, latitude 40°. It is also reported from Vancouver's Island.

2. Hyalina arborea Say. These specimens approach the variety *breweri* of Newcomb, but are much nearer the typical Eastern form. It is one of the most widely

spread nearctic species occurring on several ranges of mountains between 7,500 and 9,700 feet, as well as in the lower country, where moist enough, down to the sea level, in Ventura County, Cal., as far south as 34° 30′ near the coast.

3. Conulus fulvus Draparnaud. Six specimens closely resembling European types were found at Reed's River. East of Mono Pass, at 8,000 feet, 30 were collected, which are more depressed, lower and wider, with narrow umbilicus, thus resembling Dall's *C. chersinellus*, a form found at the Calaveras Big Trees, 4,750 feet altitude. According to Binney (Amer. Land Shells, p. 69), a similar depressed form is found in Europe (*C. mortoni* Jeff.), and another very similar was called *C. egena* Say. The only character distinguishing Dall's shell seems to be one less whorl, and still greater depression. The dimensions given by Dall are not as large as those of some varieties of *C. fulvus*, but the scale given with his figure is a third larger and liable to mislead. This species is also said by Ingersoll to go to 10,000 feet high on the Rocky Mountains, and being circumpolar, descends to the sea-level north of latitude 42°.

4. Patula striatella Anthony. A form approaching var. *cronkhitei* Newcomb, occurs at Lake Eleanor and also at Bloody Cañon, having also about the same distribution across the continent as *Hyalina arborea*, but reaching 1,000 feet higher in the Rocky Mountains and not descending to sea-level in California. It is, however, reported from Vancouver's Island.

5. Microphysa pygmæa Draparnaud. Also a circumpolar species found with the last, but not yet detected so commonly in the central mountain ranges, perhaps on account of its minute size, as it occurs near sea-level and is said to be found in many distant parts of the world.

6. Helix mormonum Pfeiffer. Found in the mountains near Lake Eleanor, between 4,500 and 4,800 feet altitude. It is also known to occur from the base of the mountains up to the Big Trees of Calaveras County, altitude 4,750 feet, and of Mariposa County, at 5,500 feet, becoming smaller with increase of elevation. A small specimen has also been found in Yosemite Valley by Mr. M. A. Knapp.

7. Vallonia pulchella var. costata Müller. But one specimen was found in Bloody Cañon, at about 8,000 feet, and it has before occurred only on the same side of the Sierra down to 5,964 at Donner Lake. On the Rocky Mountains Ingersoll reports it only between 8,000 and 10,500 feet altitude, though it is distributed across the more northern parts of both continents at lower elevations.

8. Pupa corpulenta Morse. About 50 found also in Bloody Cañon, some of which exhibit an undeveloped second tooth on the parietal wall, agreeing with some found by Hemphill in Utah. It is reported from as high as 10,000 feet altitude in Colorado, and from Vancouver's Island.

9. Vertigo ovata Say.? This species has been reported before from southern California and Vancouver's Island. Some of the specimens unlike the Eastern form have been sent East for determination as to its being a distinct species.

10. Succinea stretchiana Bland. Only six were found in the three localities, that of Bloody Cañon being 1,500 feet higher than before reported on the east slope, while on the west it descends to 3,400 feet in Plumas County.

11. Physa gabbi Tryon, var.? A few immature specimens only were found, some showing the pale

stripes often observed in specimens from alkaline or brackish water near the coast.

12. PHYSA BLANDI Lea. This common Sierra species was obtained 12 miles east of Columbia at 3,000 feet, and also near Mono Lake on the east slope. The latter are large, but as usual with this species have the spire eroded, though perfect in the young.

13. PLANORBIS. See Dr. Cooper's notes.

14. GYRAULUS VERMICULARIS Gould. Common at the two localities, and everywhere from the east base of the Sierra to the coast of California north of latitude 37°, as far north as Vancouver's Island.

15. GYRAULUS PARVUS Say. Three specimens only were found, the first reported in California, and not known from Nevada except as a fossil, though found in Utah and Colorado up to 9,300 feet.

16. GYRAULUS PARVUS ELEVATUS C. B. Adams. Thirty specimens found only on the west slope at Lake Eleanor differ constantly from Say's species, agreeing with Adams' shell, which has only been before reported from the Northeastern States. There seems to be no local cause for the variation. (See Binney's Pulm. Limnoph., p. 134, 1865.)

17. ANCYLUS. See Dr. Cooper's notes.

18. SPHÆRIUM. See Dr. Cooper's notes.

19. PISIDIUM ABDITUM Prime. This species was abundant, but only on the west slope below 5,300 feet, and was found also by Carlton at 6,240 feet in Truckee River on the east slope; also by Ingersoll up to 9,300 feet in Colorado, extending throughout the Eastern States north of 35° latitude, under several varieties. Prime has given fifteen names as synonyms of this polymorphous shell, all being connected by intermediate forms, and though he retained *P. occidentale* as distinct when first discovered,

it is very doubtful whether it is not a mere variety. Specimens found on this route and in other parts of California seem to connect them.

20. PISIDIUM OCCIDENTALE Newcomb. Numerous specimens so identified (and many of them compared with types of the Eastern species in the National Museum) were found only at the highest elevations where any mollusca occurred, and that of 9,700 feet on the east slope supplied no other species. Although first discovered near the sea-level, and common down to latitude 32° in the mountains east of San Diego, their place seems taken on the west slope along this route by the more Eastern form. Mr. Roper of Revere, Mass., who has studied these difficult shells closely, and has a large collection from both continents, considers this only a Western form of *abditum*.

21. PISIDIUM COMPRESSUM Prime. This very distinct species was as common as the other two on the west slope, but only between 8,700 and 9,000 feet in the meadows near Summit. It had before been found only on the east slope between about 4,000 feet at Owens' River and 6,000 feet at White Pine, Nev., as well as in most of the Northern States and Canada. It is reported also from Ventura County and Vancouver's Island.

22. LIMAX CAMPESTRIS OCCIDENTALIS ? J. G. Cooper. I found one slug in Yosemite Valley near Mirror Lake, but lost it by accident. It was small and dark-colored, like the form here named, which has been found at 3,625 feet on the west slope and 5,866 feet on the east slope near latitude 39°, also at 4,000 feet in Tehachapi Pass near latitude 35° by Dr. Cooper, as well as along the coast. It is now believed by Mr. Binney and others that this intergrades toward the east with sub-species *montanus* Ing. of Colorado, found there up to 8,500 feet, and through that

with the typical eastern *campestris*, while northward it runs into the sub-species *hyperboreus* of Westerlund from Vancouver's Island to Alaska.

In reviewing this list it will be noticed that the species collected are naturally grouped into two divisions; those found on the west slope, 19 species, and those from the eastern slope, 12 species, of which 9 also occurred on the west slope, while 10 were found only on the west and 3 only on the east slope. While fewer species occurred on the east, those found on both slopes reach higher elevations there, amounting to 2,000 or 3,000 feet more with 6 species and 4,000 to 5,000 in the case of two others. One *Pisidium* attained 700 feet higher elevation than any other species, a fact noticed by Dr. Cooper of the same species in latitude 39°. And as it there lives about 2,000 feet below the line of perpetual snow, it seems to have the same relative elevation here, the snow-line in latitude 38° being given by the U. S. Geological Survey at 11,700 feet near Mono Pass.

The distribution of the terrestrial species is influenced not only by the supply of moisture, but more strongly than that of the aquatic by temperature, presence of lime and suitable vegetation. Thus we found only aquatic shells above 4,800 feet on the west slope and 8,000 feet on the east.

Lake Eleanor is bordered on its north-west shores by an extensive flat, covered with meadow plants, thickets of azalea and groves of pines. Ridges and boulders of ice-polished granite traverse it near the lake, and between these, parts of the meadow were still overflowed in June, leaving ponds and mudholes in August. From these damp groves and meadows the collections about the lake were made.

In Yosemite the terrestrial species were found near the lower end of the valley below El Capitan, the spot being well shaded and always moist from a spring. Near here, the specimen of *H. mormonum* was also found by Mr. Knapp.

No land shells were found above 4,800 feet on the west slope, the soil being mostly granitic, and frosts frequent even in midsummer. The eastern slope is however covered to some extent with metamorphic rocks in which limestone is found, crossing the summit between the high granitic peaks, and may have the effect of favoring the higher range of species in Bloody Cañon. This bed of a former glacier has a little lake, formed by the moraine left by the ice, acting as a dam to the water running down toward the east. Near the head of this lake is a grove of poplars, where were found the land shells near 8,000 feet elevation.

There were some ponds just at the summit, 10,765 feet altitude, which I examined carefully, but found nothing, from which it seems probable that there are none to be found above 9,700 feet in this latitude.

The special climatic conditions at Soda Springs are of considerable interest. Situated at an altitude of 8,700 feet, near the lower end of Tuolumne Meadows, only eleven miles from Mono Pass and the Sierra crest, with snow lying perpetually near by at altitudes not much over 2,000 feet greater, the summer is of necessity short and the nights cold, with frequent frosts even in July and August. As is well known, the great Tuolumne glacier once swept over these meadows, evidence abounding on all sides in the form of polished and scored rock surfaces, and undulating, hollowed and rounded slopes of granite. In hollows thus formed, not far from Mr. Lembert's cabin at Soda Springs, water collects from the melted snows, and having no outlet forms shallow ponds, half filled with sediment and overgrown with rank aquatic grasses. The water is very shallow and must follow very closely all variations in the temperature of the air, which between night and day are large. On the twenty-first of July the temperature of the water at noon could not have been below 50° or 55° Fah. A few days before we had experienced heavy frosts nightly; the ponds were no doubt correspondingly cold.

As to the length of the season without ice I have no direct evidence, but in conversation with Mr. Lembert learned that he has been compelled to leave the meadows for his winter quarters in Yosemite Valley, on account of deep snow, as early as October. The middle of May of this year finds him still waiting in Yosemite for the season to advance far enough to allow a retreat to his home at Soda Springs. Ice forms in these shallow ponds long before the heavy snow comes, and glazes them nightly after the snow has melted. The *Planorbis*, No. 13, and the *Sphærium*, No. 18, were collected in these ponds.

The larger streams of the high Sierra are fed for the greater part of the year by melting snow. Their beds are hard granite or else are filled with bars of granitic sand. Only in meadows overflowed by the spring freshets, or in shallow ponds, or in the warmer lakes and smaller streams did I find traces of molluscan life.

For comparison I may state that only numbers 1, 4, 8, 12, 13, were found by me at Quincy, Plumas County, at near 4,000 feet elevation. See Bulletin II, Cal. Acad. Sci., p. 358, where three other land shells from there are named. I also obtained there *Limnophysa humilis* Say.

Additional Notes and Description of New Species.

BY J. G. COOPER, M. D.

	SPECIES.	West Slope of Sierra Nevada.					East Slope.				
		3625 ft., Alta, Placer Co.	3650 ft., Strawberry, El Dorado Co.	4800 ft., Bear River Valley, Placer Co.	3000 to 5000 ft., West Slope.	7100 ft., Railroad Pass, Placer Co.	7375 ft., Johnson's Pass, El Dorado Co.	6500 ft., near south end of Lake Tahoe.	6247 ft., outlet Lake Tahoe, Placer Co.	5866 ft., Donner Lake, Nevada Co.	5817 ft., near Truckee, Nevada Co.
1	Amnicola turbiniformis *Tryon*								*		
2	Vitrina pfeifferi *Newcomb*							*			*
8	Hyalina arborea *Say* (+ breweri *New.*)		*		*			*			
4	Hyalina whitneyi *Newcomb*							*	*		*
5	Hyalina subrupicola *Dall*	*									
6	Arionta tudiculata *Binney*			*							
7	Campylæa mormonum *Pfeiffer*	*									
8	Vallonia pulchella *Müller*									*	*
9	Conulus fulvus *Draparnaud*							*			*
10	Pupa corpulenta *Morse*							*			*
11	Limax campestris *Binney* (var.) . . .	*									*
12	Ariolimax californicus *J. G. Cooper* . .	*									
13	Succinea stretchiana *Bland*							*	*		
14	Physa gabbi *Tryon* (var.)				*				*		
15	Physa blandi *Lea*				*				*		
16	Limnæa stagnalis *Linnæus*								*		
17	Limnophysa bulimoides *Lea*								*		
18	Planorbis subcrenatus? (disjectus) *J. G. Cooper*								*		
19	Planorbis subcrenatus? horni? *Tryon*				*?						
20	Gyraulus vermicularis *Gould*										*
21	Pompholyx effusa *Lea*								*		
22	Ancylus caurinus (subalpinus) *J. G. C.*						*				
23	Sphærium raymondi *J. G. Cooper* . . .						*				
24	Pisidium occidentale *Newcomb*					*					
25	Pisidium virginicum *Gmelin* (var.?) .								*		
26	Margaritana margaritifera *Linn*(var.)								*		
27	Anodonta nuttaliana wahlamatensis *Lea*									*	

Mr. Raymond's collection is of much interest, for several reasons. It fills a gap in our knowledge of the subalpine mollusca at a most important point, because the most southern at which any are likely to be found up to their highest limit, as determined by climate and favorable topography. The more southern mountains, though higher, are so much steeper and cut up by deeper cañons, through which torrents rush without intervening tracts of meadow, or quiet lakes and ponds, that very few favorable locations for them can exist. Still further south none but a few isolated peaks have snow upon them for part of the summer, and the climate is so much drier that the species of mollusca become limited to the vicinity of the summits, except those native to the lower country, and not subalpine.

The only subalpine collections before made in the Sierra were by myself in 1869, and by Mr. H. P. Carlton in 1870, between 5,000 and 7,000 feet elevation, near latitude 39°, as published in these Proceedings Vols. III to V, and in Bulletin II, p. 358. In 1864 during a short visit to Lake Tahoe I also obtained some species near the south end of that lake, at the summit of Johnson's Pass and at Strawberry Valley on the west slope, which were partly described in the Proceedings, Vol. III, 1868.

As to vertical distribution, the highest elevations observed for land shells were about 6,500 feet, and three aquatic species were obtained at over 7,000 feet, or within 2,000 feet of perpetual snow, the ponds higher up containing none. The land shells, however, show a difference of 3,200 feet greater elevation in latitude 39°, compared with the perpetual snow, than in 38°, four identical species being found on the east slope in both latitudes, the *Pisidium* on the other hand reaching 2,700 feet higher toward the south. Sufficient facts on vertical range of species, as affected by local influences, have not yet been obtained to explain these discrepancies. That these were near the extreme altitudes at which they could exist in latitude 39°, is evident from facts obtained by Mr. Raymond in latitude 38°, the relative position of the snow line there being exactly in accord with the increased elevation attained by the same species of *Pisidium*. Mr. Raymond's collection also shows how much may be collected on a hasty trip made for other purposes, and with little spare time at most localities. Although many naturalists have before visited Yosemite Valley none has reported finding mollusca there, except Mr. F. A. Sampson, who obtained *Vitrinæ*, and I never saw any species from the upper Tuolumne Valley, except *Physa blandi*.

It is true that the collection made in the Mariposa Big Tree grove, about 5,500 feet elevation, contained three or four land-shells not found on this trip, yet there may have been errors as to their exact locality. The local influences of the groves are quite unlike those of the surrounding regions, as shown by two or three other species known to inhabit the Calaveras grove.

The list of Mariposa grove species given in Bull. II, p. 359, shows that it is the upper limit of five helicoid species, three of which are dwarfed by the climate, but the subalpine species were found, on this trip, to extend 2,500 feet higher on the east slope without decrease of size, while the aquatic species also retained full size. Many of them being widely spread in the nearctic and circumboreal provinces, are well known to belong to climates having as short summers and severe winters as the subalpine zone of the Sierra Nevada. If any of them inhabited this zone before the formation of the glaciers, which once covered most of it, they must have been quite exterminated, and also down the mountain slopes far below, judging from their present distance from the snow. They have therefore extended their range upward 6,000 to 8,000 feet since the glaciers retreated, now occupying the very channel cut by the ice into the solid granite, between 4,500 and 9,700 feet elevation, for a distance of over 30 miles east and west. Such an extension must have been exceedingly slow, especially for the aquatic species moving up against the streams, unless aided by birds, which might have carried shells or their eggs adhering to their feet. The glaciers in this latitude extended east to Mono Lake, giving them a total breadth of over 50 miles, and the highest peaks now rise over 13,000 feet above the sea.

We see here the same difference in elevation of several species on opposite slopes as in latitude 38°, the land-shells especially going higher on the eastern slope. This difference may be caused by the greater amount of snow falling on the west slope, which must lie longer on the ground and shorten the active season for these animals, though the average temperature must be milder on the west slope and also moister, which may favor the existence of some of the larger species, not found eastward, such as *Campylæa mormonum* and *Triodopsis loricata*, up to Alta, 3,625 feet, and to Mariposa Big Trees, 5,500 feet. There is also a marked absence of limestone between 5,000 and 9,000 feet on the west slopes in both latitudes. The little lakes on the west slope in latitude 39° above 3,600 feet seem very destitute of mollusca as are the violently running streams.

For comparison I give a list of the species so far collected in the subalpine region near latitude 39°, showing that although the number is about the same, the species found differ in a marked degree, chiefly from local causes.

In the first table, one species *(Campylæa mormonum)* is merely a straggler from the mild Californian region into the subalpine, which indicates the lower limit of the subalpine on the west slope to be between 4,000 and 4,500 feet, near latitude 38°; and as the lowest level of the Great Basin on the east slope is not much, if at all, below 4,000 feet, the whole of the basin region north of that latitude is referable to the subalpine mollusc-fauna.

In the last table, both this and *Arionta tudiculata* are found on the west side, near the lower limit of the former glaciers, and the *Limax* also near their limit on the east slope, but future collections may alter these ranges.

As to the aquatic species the large supply of fresh water in the Lake Tahoe basin causes apparently a great increase of their numbers, and in both tables only the following are unknown below the subalpine region in the same latitudes, viz., the planorbis, pompholyx, ancylus and sphærium. It is also noticeable that seven land and ten water species have not been found in latitude 39° above 6,500 feet (near Lake Tahoe), leaving but three as yet known from the higher locations. Near latitude 38° there were sixteen species found between 6,500 and 9,700 feet altitude, partly on account of the nature of the country being more favorable for their existence.

The glaciated region extended over the lake basin, having a total width of less than 40 miles, and the highest peaks are now less than 9,500 feet high.

SPHÆRIUM RAYMONDI, n. sp., Plate I, figs. 1–8. *Spec. chars.* Adult shell ovate trigonal, nearly equilateral, much inflated, the greatest convexity near the middle, fragile, translucent; beaks central, slightly turned forward, very strongly calyculate; margins forming a subovate outline, the anterior obtusely rounded, posterior usually obliquely subtruncate; base curved equally with the hinge-margin, the edges of valves meeting at an angle of about 80°, not flattened nor spreading laterally; the anterior very little lower than posterior, but slightly sharper. Divergence of upper margins from umbonal apex, 80° to 90°. Color pale pearl-gray, sometimes iridescent, often with a narrow yellowish marginal band; epidermis tinged olive, wearing off in adult, surface smooth, shining; growth-lines very faint, inside of shell white. Younger shell more oval, beaks less prominent, the calycles in shells not half grown being everted when seen from end of shell, instead of inverted (fig. 7). Fry oblong-oval, much compressed, its valves very distinctly seen in calycles of adult. Soft parts yellowish, tinted with red, the colors visible through shell. Length, 0.30 to 0.34 inch; height, 0.26 to 0.30; diameter, 0.16 to 0.21. Fry, 0.05 to 0.06 long; 0.04 to 0.05 high; 0.02½ to 0.03½ thick.

Varieties. Specimens vary more or less in one or more of the dimensions, in the curves of the outline and in convexity, but not over 0.05 inch. The characters of young shells, as seen in the figures, are sometimes persistent in adults, altering the form more or less, but as the figures are three times the diameters of shells, those differences are not so perceptible to the eye as shown in the figures.

Figures 9 and 10. We have included these two specimens for comparison, with some doubt whether they are not of a different species, They were collected in Klamath Lake, Or., by Mr. A. Forrer, of Santa Cruz, Cal., and kindly sent to us by Mr. E. W. Roper, of Revere, Mass., who writes that in his opinion all found were immature. They differ from *S. raymondi* in having a thicker, brown epidermis and in higher beaks, but less prominent calycles. By comparison of the beaks with the young of the former (figs. 5 to 7), it will be seen, however, that they are nearly mature, and in their outlines come nearer to figures 3 and 4 than to any others.

It has been supposed by some that *S. raymondi* is only the young form of some rhomboidal species, but the fry taken from shells like figs. 1, 3, 4 prove their maturity, and we also give figures to show forms of the young.

To settle the relation between it and the only other allied species known on the West coast, as well as with some Eastern forms, we figure several more for comparison.

S. LENTICULA Gould, figs. 11, 18, 19. This figure (11) is taken from a specimen I obtained near Visalia, and now in the State Museum, Berkeley. It differs from the shell figured by Prime in a much more rounded form, greater convexity and a little larger size, showing that the rhomboid outline and consequent truncation are not the constant effects of full growth. It is shown by the following comparison that considerable variation exists in the dimensions and proportions of adult examples from various localities, the most northern being broader and flatter, a difference apparently existing also in some Eastern species.

	Figure.	Length.	Height.	Diameter.
Gould's type	18	0.43	0.37	0.18 (Prime.)
Visalia examples	11, 19	0.44	0.38	0.24
Marin County examples		0.46	0.38	0.20

The height and diameter are shown in diagram by figs. 18 and 19, by which it seems that the shell is sometimes very near in convexity to *S. partumeium* Say, and in one of Prime's latest writings, quoted by Dr. Yarrow in the quarto report of Capt. Wheeler's Arizona Expedition, 1874, he mentions specimens of *S. lenticula* from there, which were also intermediate between the type from Carson River and *partumeium*, suggesting that this form (fig. 11) is merely an extremely inflated form of *lenticula*.

The description of "*S. partumeium*" by Prime also includes three forms varying in size, in convexity, and in height, which had been first described as species, while the figure given is shorter than the type described, being, like that of *S. lenticula*, a rare extreme.

S. PARTUMEIUM Say. The specimens nearest to this species that we have, are figured as Nos. 12, from Worcester, Mass. (showing hinge), and 13, 14, from Columbus, Ohio. Though smaller than Prime's largest, as shown in the diagram, fig. 15, they have a similar relative convexity, and come nearer his description than his figure, no other calyculate species approaching this both in size and convexity.

	Figure.	Length.	Height.	Diameter.
Prime's type	15	0.50	0.43	0.31
Worcester example	12	0.38	0.33	0.22
Columbus examples	13, 14	0.37	0.33	0.21

The two latter, however, in outline much resemble *S. truncatum*, though not subangled at the upper margin as figured by Prime, and are perhaps nearer to the next mentioned species.

S. SECURIS Prime, figs. 20 and 21. The shells we select to represent this form are from Plattsburg, N. Y., the largest being very closely like Prime's type in outline, while the convexity is proportionately the same, as shown by the diagram of Prime's type, fig. 16.

It is evident from a comparison of Prime's descriptions, that figures 46 and 47 (*S. contractum*), on p. 49 of his Monograph, have been accidentally transposed by the printers, which is confirmed by inspecting his first figure of *S. securis* in the Annals N. Y. Lyceum of N. H., Vol. V, Pl. vi, where a smaller one is figured.

Fig. 46 being *S. securis*, is represented as differing from *S. truncatum* chiefly in greater convexity, and the variety *cardissa* was described by Prime as a still more rounded form, connected by gradations. As is shown by the diagram, the convexity of Prime's type is relatively the same as that of his "*S. partumeium*," and from the connecting links shown by our figs. 12, 13, 14, as well as its limitation to the northern tier of States, it seems most probable that *S. securis* is only a stunted variety of *S. partumeium* Say. The same error of using the figure of *S. contractum* for that of *S. securis* is copied by Binney in his edition of Invert. of Massachusetts.

	Figure.	Length.	Height,	Diameter.
Prime's type	16	0.37	0.31	0.25
Plattsburg examples	20, 21	0.28	0.24	0.15

S. TRUNCATUM Linsley, figs. 22, 23, 24, 25. These are selected specimens having the least convexity of any, out of numerous similar forms from several Eastern States, these agreeing best with Prime's description. They are, however, all smaller, less rhomboid and subangled, more convex and more rounded than his type which represents apparently a rare extreme in form, while many occur more or less intermediate.

Diagram, fig. 17, represents the convexity given by Prime for *truncatum*, a flatness not seen by us in any of numerous specimens, and closely agreeing with that he assigns to *S. lenticula* (fig. 18), which he says is "so similar in nearly every respect to *S. truncatum* that it is difficult to tell them apart." It appears, however, from later specimens of *S. lenticula* that it is quite as closely connected with *S. partumeium* (see notes, p. 76), and it follows that all four so-called species may yet be combined under the last name, or rank only as subspecies. It is possible that the flattest forms represent in all cases the most northern grown specimens.

	Figure.	Length.	Height.	Diameter.
Types of Prime	17	0.37	0.31	0.15
Baldwinsville	22	0.29	0.24	0.14
Baldwinsville (Fry)	23	0.03	0.02⅔	0.01⅓
Michigan (Young)	24	0.19	0.16	0.12
Readville, Mass.	25	0.32	0.25	0.15

To show still further that Prime's types are not the usual forms, but extreme varieties, it is noticeable that other authors give less different measurements, as follows:

	Length.	Height.	Diameter.
S. partumeium *Say* (type)	0.55	0.45	Say does not give it.
S. partumeium *Gould*	0.45	0.40	0.27
S. securis *Gould*	0.33	0.25	Moll. of Mass. not given.
S. truncatum *Gould* (type)	0.33	0.25	0.20
S. lenticula *Gould* (type)	0.40	0.30	Not given.

By drawing diagrams from these figures, the outlines of the four forms are found much more alike than those of Prime, the diameters also being closely like those in our plate.

To show that young shells of the rhomboid group do not much resemble that of *S. raymondi*, figs. 5 and 24 are comparable. The variations of the latter species from age, etc., show how much should be allowed for variation in other species.

In comparing our figures with those given of the same species in Prime's Monograph of Corbiculadæ, it will be noticed that the latter give the impression that the shells are much more angled in outline and in the umbonal expansion than the photograph shows them to be. While there can be no doubt of the accuracy of photographs, it may be said that ours do not represent fully adult shells. While admitting this as to some Eastern species, we show that the Western species (*S. lenticula*, fig. 11) is larger than Prime's figured type, and yet it does not exhibit any better the angulation and truncation given in his figure more strongly than in any of the allied forms. His artist or engraver, making small wood cuts, apparently cut the distinctive features rather more strongly than they exist in nature.

In many cases the figures and descriptions do not agree even as well as would be explained by allowing variations of 15 to 20 per cent. in dimensions. The size of shell, combined with "other signs of maturity" and the finding of fry within them, have been considered the best proofs of an adult condition, but we find that the latter is not quite reliable. For instance, specimens like fig. 3 of *S. raymondi*, and others smaller than figs. 21, 22 or 25 of the same Eastern species, contain fry, the shells being immature. It appears probable that the shells may continue to grow for some time while the fry are forming, and only liberate them when quite mature. As to size, we have remarked that there seems good reason to believe that this may be much influenced by environment, and cannot be considered proof of distinctness, the same law being well known to apply to other fresh-water shells.

The calycles, which form such a remarkable character of this division of *Sphærium* that Prime proposed to make a subgenus of it, give us great aid in determining maturity, especially in the more convex forms. It appears from the profile figures that the most marked external character distinguishing young from adult shells is the position of the calycles on the beaks, these being at first everted, and becoming more inverted as the shell grows larger, until they meet in the middle line. Thus it seems that the shell fig. 10 must be more mature than fig. 3, and the profile 14 has the beaks closer together than any other, leaving no room for more inversion, and proving maturity. Fig. 21 seems less mature by this character than either 3 or 11, but illustrates most nearly the convexity of the form. Considering the variability of all fresh-water mollusca, and also the extent of variation observed in different examples of many marine bivalves, there is little doubt that Mr. Prime himself, if living, would now combine many more of his nominal species than he did in 1865. From the descriptions given by most authors, it seems almost certain that the three forms nearest allied to *S. truncatum* are scarcely separable, as species, from the Eurasian *S. calyculata* Drap.

Other calyculate species.—Six other forms of this group are given by Prime, some having a little resemblance to *S. raymondi*. *S. elevatum* Hald. and *S. sphericum* Anth. have the hinge margin even more curved, but are more rounded and the first flatter. *S. rosaceum* Prime, differs in smaller size, form nearly as in the Klamath shell (figs. 9, 10), but longer and less high, with reddish-brown epidermis, and nearly straight hinge, like the other three. I have seen Californian specimens so labeled, but of a pale color, perhaps immature examples of *S. raymondi*.

A new species from the Uintah range in Wyoming, described in 1886 as *S. uintahensis* Call, from an elevation of 10,500 feet in a snow-water lake, is nearly a perfect globe.

Iowa seems the most prolific of the States in this genus, as twelve species are recorded by Prof. B. Shimek, six of them calyculate, but no proofs are given of their authenticity.

S. cooperianum Prime, n. sp., is given as a name only in his last catalogue of Corbiculadæ (Amer. Jour. of Conch. VI, 1869). This was never described, because the specimens I sent him were believed to be immature, so small in fact that I supposed they were *Pisidiums*, but he wrote that the ligament was on the longer side as in *Sphærium*. They were from the little lake over 7,000 feet elevation in Johnson's Pass, south of Lake Tahoe. It is probable that they were young of *S. raymondi*, but their present location being unknown, the locality must be revisited to determine the species.

From the preceding comparisons we conclude that the number of nominal species will bear still further reduction, and that more study of different ages and variations will alone prove which are the leading types.

Following Prime's suggestion, it is desirable to give a name to the calyculate group, and certainly none can be more appropriate than PRIMELLA, which perpetuates the memory of the most thorough student of the genus. It is possible that it may even supersede that of *Sphærium*, as the genus *Spheria* among Fungi has nine years priority.

ANCYLUS CAURINUS W. Cooper, subsp. SUBALPINUS. Apex about one-third the distance from posterior end, outline elliptic, sometimes widest at middle, sometimes about anterior third, apex slightly turned to the right; anterior surface somewhat convex, posterior a little concave or flat; breadth a little under one-half, height over one-third of length; fragile, horn-color, paler in thin specimens.

	Figure.	Length.	Breadth.	Height.	
Original type		0.24	0.14	0.09	caurinus.
Oregon example	26	0.21	0.13	0.07	subalpinus.
Yosemite example	27	0.23	0.12	0.07	subalpinus.
Bloody Cañon example	28	0.21	0.13	0.07	subalpinus
San Francisco, type		0.16	0.04½	0.04	fragilis.
E. of San Francisco Bay	29	0.11	0.07	0.04	fragilis.

The original *A. caurinus* was named in the report of Pac. R. R. Surveys, XII, ii, 1859 (Natural Hist. of Wash. Ter.), and a type figured by W. G. Binney in Land and Fresh-Water Shells, Part II, p. 144, 1865, without description. In 1870, I published the description in our Proceedings, Vol. IV, p. 92, from which the above is copied with some changes, so as to include the Oregon and subalpine specimens. The dimensions of the type are given more accurately from Binney's figure, and those of the others as figured, from the examples themselves. It thus appears that the Oregon and subalpine forms are nearly of the same form as the original from

Black River, Wash. Ter., but each shows slight differences, hardly specific.

Fig. 26 has the sides less parallel, or straight, the posterior slope flatter; fig. 27 is wider before apex as is fig. 28, but less oval, both approaching the outline of fig. 29, but being much larger.

The nearest approach to *A. caurinus* seems to be in *A. ovalis* Morse, from Maine, but that is less than half as large, pale yellow and wider in front. (See Binney's L. and F. W. Sh., II, 156.)

A. FRAGILIS Tryon. In the synopsis in Vol. IV, I considered *fragilis* a small variety of *caurinus*, having "apex more posterior, lower, narrower, anteriorly wider," and in those points the other three forms here figured are indeed intermediate. But in size they are like *caurinus*, while the numerous specimens of *fragilis* since found in various portions of California, below 500 feet elevation, all have nearly the same size and form as the type. Those figured show that its variations in width are great, if the type is as narrow as stated by Tryon. I have, however, never seen any like it in that respect, and Tryon's remark that its "sides are nearly parallel, or slightly incurved in the middle," show that one of its characters most like *caurinus* is not constant. The usual oval form, more abrupt slope behind and small size, may be considered proofs of specific distinctness, until more connecting links are discovered. Both *fragilis* and *caurinus* have been called similar to *A. parallelus* Hald., but are quite distinct, *fragilis* being much nearer to *rivularis* Say.

Another peculiarity of this small species is its close likeness in form to the first stage of growth in *Gundlachia californica*, the two being found together, and are possibly only one species at different ages.

In Binney's work, p. 139, he mentions in a foot note, "Dr. J. G. Cooper found *Ancyli* 7,100 feet above the sea in the Sierra Nevada." This locality was near that of the *Sphærium* in Johnson's Pass, but by some mistake Mr. Binney seems to have referred the specimen to *A. caurinus*, as he tabulates it on p. 145 as "No. 9,098 from California (Judge Cooper)," the type of *A. caurinus* being really from Black River, as stated at top of the page. It was probably one of the forms here called *subalpinus*.

Another error on p. 144 is quoting No. 9,203 "*A. patelloides* Lea," as from San Francisco, no species like it being known from near the bay, the nearest being from northern California.

While the forms here figured are not very similar to any other American species, it is remarkable that a tertiary fossil species of Western Europe (*A. matheronii*) has almost exactly the form of *A. fragilis* here given, with the size of *A. caurinus*, or larger. It is figured in Nicholson's Manual of Palæontology, Vol. II, fig. 45. The only species yet found fossil in the United States are very different, but rather closely related to *A. crassus* and to *Acroloxus nuttalli* of Oregon. (See "Non-Marine Foss. Moll. of North America," by Dr. C. A. White, in 3d Ann. Rep. of U. S. Geol. Sur., 1881–2, p. 451, and figures.)

PLANORBIS SUBCRENATUS Carp., var. DISJECTUS, fig. 30. Characters. Differs from the typical form in having but four whorls, more rounded, smoother, and the outer ones more or less irregularly coiled, in a different plane from the inner. Length 0.70, height 0.50, breadth 0.30 inch. Varies considerably in height and breadth.

This form has the same deformity on which E. Ingersoll founded his "*Helisoma plexata*" (Report of the Geol. and Geog. Survey of the Territories, 1876, p. 402). Our upper figure shows the same style of dislocation in the whorls as represented in his figure, but we find also every degree of variation in their irregularity that seems possible, while some are normal. The figures also show how much variation occurs in proportions of different specimens. Besides this, in examining any large number of specimens of any species, we find some in which more or less irregularity of one or more whorls exists. *H. plexata* is stated to agree in every other respect with *H. trivolvis* Say, and the figure shows no other differences. It is therefore evident that it is nothing more than a variety, and considering its occurrence chiefly in subalpine regions (his being found only at 9,700 feet elevation in the Rocky Mountains), we may safely attribute it to debility in the animal, caused in these lofty localities by insufficient heat of the water, at some time during the animal's growth. In the irregular growths found in lowland examples, a deficiency of food or some impurity of the water may be a probable cause. It must be remembered that the animal crawls with the shell vertically supported on its back, and thus a condition of debility will allow the weight of the shell to incline it to one side, and its growth, by additions at the mouth, becomes changed in direction, thus altering the plane. In several species we observe this deflection of the mouth taking place just before the maturity of the shell, when it is probably weakened by age, and so constant is this in some of them that it is called a specific character.

Mr. Ingersoll found *H. trivolvis* normally developed up to 8,000 feet elevation, and Mr. Raymond also found that the number of deformed shells was least near Hetch-Hetchy Valley, 4,100 feet, more at Lake Eleanor, 4,600 feet, and constant at Soda Springs, 8,700 feet. In all cases they inhabited only shallow weedy ponds, none being in the lake or rivers. These being fed from melting snow are much colder than the ponds, which reach a heat of 50° or more in summer.

In referring this form to *P. subcrenatus* Carpenter, we have considered it as an alpine variety of the most similar and first described species of its group from the west coast. Taking *P. corneus* as type of the genus *Planorbis* we find it to be a nearly perfect cylinder, coiled however in a plane inclined to the left, so that its two sides are dissimilar, unlike some species which have them nearly or quite alike. Variations from this type in large American species consist chiefly in the coarser growth lines, not concealed by a thick epidermis, and in more or less lateral narrowing or angulation of whorls.

Carpenter in describing *P. subcrenatus* evidently compared it with *P. corneus*, being little acquainted with American species, and gives undue importance to the coarse growth-lines which he calls "occasionally minutely crenulated ridges," also quoting from Cuming's manuscript that it "differs from *trivolvis* in the acuteness of the ribs, and in their being more distant." These characters would not be considered of much specific value by American authors, but they show some difference from *P. glabratus*, often considered a variety of *trivolvis*, and which otherwise comes nearest to Carpenter's species. It will be observed that he makes no mention of any carina nor angle on the side or mouth of the shell, no such character being shown in the figure by Binney, said to be from the type.

Seven years later he states that "it is quite possible that this may prove a very finely grown specimen of *P. lentus*. Dr. Kennerly's shells are intermediate." (See "Mollusks of Western North Amer.," Smithsonian Reprint, p. 675 (161), which gives his latest known opinions, in 1872.) He does not give reasons for this belief, and we must suppose he had not compared it with *P. glabratus*.

In the Proc. Cal. Acad. Sciences, Vol. IV, 1870, p. 100, I followed Binney's Land and Fresh-Water Shells in giving *subcrenatus* as a good species, but stated that "specimens common inland closely resemble *P. glabratus*," giving the distinctions between them. I still think there are sufficient of these to retain the Western form, as a subspecies at least, larger and rougher, with more cylindrical whorls. If, as Ingersoll states, *P. glabratus* is a reversed shell, the difference is still greater. But Say's description only calls it sinistral, just as he did every other *Planorbis* he described, except *P. corpulentus*, and the latter, if any, would be a reversed shell. The similarity of the sides in *glabratus* would allow of either conclusion, but the form of mouth in Binney's figure seems like that of other dextral species.

P. HORNII Tryon. In an article by Mr. H. P. Carlton, published also in Vol. IV of our Proceedings, this name is given to young shells from the head of Truckee River, in Lake Tahoe, Placer County, also said to be "found larger by Mr. S. Brannan at about 3,600 feet elevation on the west slope." The latter I understand to have been determined by Tryon himself, and I was thus induced to agree with Mr. Carlton, but not having specimens to compare, he left the name as *P. hornii* with a (?). Mr. Raymond also obtained some at Quincy, Plumas County, which seem to show the characters of var. *disjectus*, but are a little larger and with whorls a little more convex, also showing more or less irregularity. It is therefore probable that this form inhabits the whole range of mountains, descending at least to 3,383 feet in Plumas County.

We had considered this as *P. hornii*, but Mr. Dall, "by comparison with types," says that the latter is not so flat a species, and inclines to call the variety *P. tumidus* Pfeiffer (1839), described as from tropical America. There are differences in his description, however, besides the doubt whether a flatter subalpine shell can be allied to a tumid tropical species, while we have some as near like it farther north.

P. hornii was described as from the coast, at the southern boundary of Alaska, latitude 54° 40′, and seems more like a small form of *P. corneus* than of any North American shell. It would not be strange if that Eurasian species could have been transported across the Pacific by birds, and formed a varietal colony on this side. But its alliance is perhaps as close with *P. subcrenatus*, and since it may prove only a small form of the latter, we prefer to use the prior specific name for our flatter irregular variety. If, as Carpenter suggests, there are specimens connecting *P. subcrenatus* with *P. lentus*, they may be supposed to be still nearer to his *P. tumens*, but the former name has a year's priority. We have not, however, seen shells from Oregon with the sharp carina and subtriangular mouth of the latter, which, he also suggests, may connect with *P. lentus*. It is evident, however, that he only described the young, or a small race, of *P. tumens*, for while we find them near San Francisco Bay exactly like his Mazatlan types, we also find much larger ones in warmer localities.

P. TUMENS Carpenter. In studying large numbers of the west coast species from many localities since 1870, it has become necessary to make another change in the Synopsis of Fresh-Water Shells, given in Vol. IV. The first section of *Planorbis* there given has "only three whorls visible above," a character common to many species, including *P. corneus*, and therefore not at all peculiar to *P. trivolvis*. Then, adopting the subgenus *Helisoma* Swainson, a new species is given as *P. (H.) occidentalis* J. G. Cooper, with "whorls five or six, nearly all visible above, much narrowed and subangled below, nearly smooth, mouth little higher than wide, diameter 0.80 to 1.12, altitude 0.50 to 0.70." While this was unlike any described form, and had the somewhat enlarged outer whorl of *Helisoma*, many intermediate specimens now prove that it is only the mature form of *P. tumens*. Its last whorl is not really more disproportioned than that of a very large *P. corneus*, and, together with some other species, it shows that subg. *Helisoma* is untenable. Its nearest Eastern analogue is *P. lentus* Say, and that has been by many considered only a variety of *Helisoma trivolvis*. The figures given show ours to have the form of a non-carinate species. We consider the carination, first used by Say as a specific character, more important for the grouping than the later subgeneric divisions, and it also serves in many cases to determine young shells, which have been often described as new species.

It is used also as an important character in the differentiation of *Menetus*, *Gyraulus*, etc., being in them marginal instead of lateral, and while such forms are of very ancient date geologically, the lateral carina seem to appear only in the recent period. The maximum of carination is reached in the allied genus *Carinifex*, only known in late tertiary and recent epochs. A rounded or blunt angle is not intended by the word carina, which must be sharp.

One reason given for supposing immature shells to be good species is that they are found in springs and ponds without larger ones. It is yet to be determined whether they reproduce in these cases, or whether ova brought on the feet of water birds merely hatch and die when the drying up or stagnation of the water stops their growth. There are, however, many dwarfed races or subspecies of fresh water mollusca produced by unfavorable environments more or less permanent.

As tending to prove that the species here mentioned are not merely local races of one 3-whorled *Planorbis*, it may be stated that *P. subcrenatus* has been identified from Honey Lake, Cal., and Nevada, by R. E. Call in 1884, and *P. hornii* was received by Tryon from Grant's Lake, on the Oregon-California boundary, in 1866 (collected by W. M. Gabb), both localities near the Sierra Nevada.

Going back to the earliest known fossil *Planorbes*, we find that *P. veternus* M. & H. of the Jurassic of Nebraska was (like *P. vermicularis*) only 0.16 inch in length, and its section shows also four whorls of the simplest cylinder form. About fourteen other species have been found in the Laramie, Eocene and Miocene strata, all quite unlike living American forms. One of late tertiary age has been found in California, which is more like them, and the great extinct lakes of the Central Basin contained only species now living near them.

EXPLANATION OF PLATE.

1-8—Sphærium raymondi. 1*a*, section profile of figure 1.

9-10—S. ———, Klamath Lake, Oregon.

11—S. lenticula, from near Visalia, Cal.

12—S. partumeium, Worcester, Mass.

13, 14—S. partumeium, var.?, Columbus, Ohio.

15—S. partumeium,
16—S. securis,
17—S. truncatum.
18—S. lenticula,
} Section profiles from Prime's dimensions of his types.

19—Profile of figure 11.

20, 21—S. securis var., Plattsburg, N. Y.

22-25—S. truncatum, Massachusetts and Michigan.

26—Ancylus caurinus var., Oregon.

27—A. caurinus subalpinus, Yosemite Valley.

28—A. caurinus subalpinus, Bloody Cañon, Cal.

29—A. fragilis, near Oakland, Cal.

30—Planorbis subcrenatus disjectus, Tuolumne Meadows, Cal.

Figure 30 is of natural size; all the others are magnified three diameters, and were drawn from photographs, except the diagrams. In this way some of the specific characters are better developed, without sacrificing the accuracy of the photographic outlines.

PRELIMINARY DESCRIPTION OF A NEW SPECIES OF THE GENUS LEPUS FROM MEXICO.

BY WALTER E. BRYANT.

Lepus insularis, sp. nov. Black Hare.

Sp. char.—About the size of *Lepus californicus*. General color of upper surfaces of body, head and tail, black; under surface of body pale vinaceous-cinnamon, becoming decidedly darker towards the sides where it blends with black from dorsal surface. Ears gray, tipped with black; a narrow, well-defined line of white along the inferior margin of ear. Chin and orbital region, grayish white. Cheeks gray. Throat cinnamon-rufous. Under surface of tail nearly the same color as throat. Upper surface of fore feet and legs cinnamon-rufous, nearly obscured by black-tipped hairs. Upper surface of hind feet grayish white; toes brownish; black between digits. A black line extending along inner sides of hind feet from toes to and a little above the heel. Soles of feet heavily padded.

Type. No. $\frac{298}{301}$, ♂ ad. California Academy of Sciences. From Espiritu Santo Island, Gulf of California, Mexico, November 2, 1890. Collected by Walter E. Bryant. (Original number, 508.)

Type. No. $\frac{299}{302}$, ♀ ad. California Academy of Sciences. From Espiritu Santo Island, Gulf of California, Mexico, November 2, 1890. Collected by Walter E. Bryant. (Original number, 509.)

Two other specimens collected at the same place and time and two from the U. S. National Museum, collected by Mr. L. Belding in 1882 have been examined. Cranial characters and measurements are unavoidably deferred to a later paper.

DESCRIPTION OF THE LARVA OF DASCYLLUS DAVIDSONII LEC., AND A RECORD OF ITS LIFE HISTORY.

BY J. J. RIVERS.

Form large, robust, elongate, attenuate ventrally, eyeless, hexapod; segments 12, exclusive of head; color testaceous; texture corneus; length $1\frac{1}{4}$–$1\frac{3}{4}$ inches. Head wider than long, convex; genæ strongly rounded; sides gently rounded; front margin truncate with slight sinuations; from the front angles arise four jointed antennæ, the second joint being as long as the other three, the basal joint connate with the head, and the apical joint can only be seen peeping out from the third by being highly magnified; a large trapezoidal labrum projects from the front margin; the front margin of the labrum is deflexed and fringed with bristles. Mandibles robust; articulating with the front edge of the head; apex bifid (plate II, fig. V, upper side); the cutting surfaces are broad, bearing both crushing and tearing teeth (fig. Va); the large dark character at the base is boldly raised above the general line of the cutting edge. The masticating surface is sunken except at the basal inner angle, but it has a reflexed margin (fig. Va, d); the space marked (Va, e) is a sunken hollow bearing a transparent film, which alone separates the outer from the interior walls; near the middle of the mandible occur two needle-like teeth, one of which is very aciculate (fig. Va, f). Maxilla (fig. III), bears a bidentate lacinia (A), a robust galea (B), and a three jointed palpus (C); labium bearing its two jointed palpi, (fig. VI). Leg showing peculiar joint; (fig. VII). Interior of labrum showing epipharynx, (fig. II). At the entrance under the front margin is a tuft or boss of stiff bristles (fig. II, g); immediately behind this is a character shaped like a horse shoe, and consisting of a series of horny teeth, shining black in color. The lateral series may be described as containing nine well formed, conical teeth, and the middle series consisting of three horny pieces, the one in front conical, the two behind elongate; there are also two independent pieces on either side. These four pieces last referred to are all black and horny in texture but are not in high relief like the teeth. Fig. IV represents the hypopharynx and basal joints of the labium. The characters here are almost a repetition of those found in the epipharynx but they are more robust. They present a great resemblance to the upper and lower jaws of the vertebrata, the vertical movement of the labrum and labium makes the likeness complete, the single tooth in each of these parts standing in the position of an incisior tooth, and no doubt performing incisors work, while the lateral series most certainly carry on the functions of molars. The interior organization of the mouth is surely of a high order, for though the mandibles are the true incisors, yet in the interior more dividing is to be done, and if this insect could only be classed with the Urodelæ, these teeth would bear the names of vomerine and palatine, which they more resemble than ligula and paraglosse.

THORACIC SEGMENTS.

1st seg. more than twice as wide as long, front and hind margins parallel; sides boldly rounded in front, obtusely behind; sides of the thoracic segments deflexed.

2nd seg. the narrowest; just behind the front margin is a raised line not parallel.

3rd seg. wider than the second; has a fine parallel raised line in front and a divided line, not parallel near the hind margin.

ABDOMINAL SEGMENTS.

4th–8th inclusive; all of the same character, but decreasing in width; the sides are deflexed, then inflexed and wrinkled, forming a lateral margin; on the dorsal region there are two raised lines, one parallel to the front and the other to the hind margin of each segment; that near the hind margins is formed of pointed tubercles.

9–11 segs. are much alike, each possessing a parallel raised line just behind the front margins.

12th seg. front margin truncate; sides and hind margins rounded. Sides of the head and of the thoracic segments, and the surface of the 11th and 12th all over are beset with short bristles. On each of the abdominal segments except the ventral, is a spiracular opening upon the deflexed portions.

HABITS.

This larva lives a solitary subterranean life, burrowing into heavy, loamy soil and dwelling a long period in the same tunnel of half an inch in diameter and more than a foot deep. It grows to a large size when compared to the dimensions of the perfect insect. The period of existence appears to be more than a year, as larvæ are found at the same time, which, by the size, color and texture, would suggest a three years larval condition. In former attempts to rear this insect two years elapsed without change in the larval condition, and it may fairly be assumed the cause of failure to get it, through its changes arose from the prolonged stages; it becoming difficult to preserve full natural conditions, particularly for such long periods. Its usual habitat is among the rootlets of heavily foliaged trees where the ground does not dry nor bake. In 1887 they were numerous under an oak tree at Berkeley. The exact place had been filled up with heavy loam that was but one remove from clay; it had been carted to the place two years before and covered a deposit of grass and leaves. As the leaves and grass decayed, a narrow space or crevice was formed, and in this was found numerous collections of clay pellets that appeared like the excrement of mice. The tunnels were plentiful, some above and some below this crevice, but many had an outlet into this fissure and some ended therein. A number of these larvæ or grubs were removed from their habitat and placed in a box with earth and roots from a garden; the box let into the ground, and though all care and attention was given them and though many were large and robust the new conditions did not suit them. Some continued living for a whole year but they all finally died, not one reaching the perfect state. During examination pellets were found in the box and this fact explained the nature of them; they were noticed to be of a different color, which suggested another fact—that their food had been improper. The next experiment was made with the clay and materials found in their habitat and they passed their metamorphoses in regular order. It appears that this insect when in the grub state requires clay as part of its diet.

14 pellets, (fig. VIII), air dry, weighed	0.354	grams
Weight after being burnt	0.230	"
Loss by ignition	0.115	"

What nutriment this insect can extract from clay can only be conjectured, as the qualificative admixtures are unknown; the mycelium of fungi may constitute a portion of the material for tissue building; but as this is also doubtful the explanation is not forthcoming. If the proportion of refuse be taken as a criterion the earthy matter is exactly two-thirds of the whole food.

NEW SPECIES OF SCARABÆIDÆ.

BY J. J. RIVERS.

Lygirus Bryanti, n. sp.

Form elongate, oval, strongly convex, shining; color above dark chocolate to black; below, rich dark chestnut, but ventrally darker.

Male.—Head sub-triangular; sides oblique, faintly emarginate; clypeus armed with two flattened reflexed spines near the apex; two rather prominent tubercles on the frontis, one on either side of the center; on the vertex a transverse, smooth elevation; all the other surface closely rugose-punctate. Prothorax wider than long, narrow in front; front margin deeply emarginate with angles prominent; sides gently rounded, increasing backwards till nearing the hinder angles which are gently rounded; all round there is a clean cut edge except at the the base where the feeble bisinuations interfere; disc very convex, highly polished; the usual central tubercle just behind the front margin and rising in front of the usual dorsal depression having a rugulose surface; a twin depression or indent a little in from the hinder angles; remainder having the shallowest kind of punctures, strongest at the front angles and along the sides near the margins, but nearly obsolete on the central area and at the base near the hind margin. Elytra rather wider than the thorax at their juncture; sides nearly straight; a slight sinuation behind the humeral angle; base emarginate; humeral angles prominent, impunctate, shining; margin extending to the apex where it becomes very narrow, but boldly encircling the humeral angles; a broken sutural stria defined at apex, but not reaching the scutellum; the basal, scutella and sutural area reaching to and including the apical umbones highly polished, representing a third of the entire discal space; geminate series of striæ, faintly impressed with quadrate punctures. Pygidum much wider than long; obscurely punctate, each puncture bearing a short hair. Abdomen with reddish hair on the outer ends of segments; the anal segment bearing a complete fringe of stout reddish bristle-like hair. Legs short and robust; anterior tibiæ strongly tridentate, the teeth being deep black; spines of the legs dusky, otherwise chestnut. Length, 24 mm.; width, 7 mm.

Occurs at San José del Cabo, Lower California.

This fine insect belongs to the Pentodontes group of the tribe Dynastine, and was taken with several others by Mr. Walter Bryant during one of the tours of exploration sent out annually by the California Academy of Sciences for the purpose of bringing to light the faunal and floral riches of Lower California. Among the collection are many of the fine and well known species of Coleoptera. Besides this one there are three others that are new to science, and Mr. Chas. Fuchs who is arranging them suspects there are more that will turn out to be new.

This new species, *L. Bryanti*, is easily separated from the others of the genus by bearing a higher polish, by being longer and more convex.

ON LAND AND FRESH WATER SHELLS OF LOWER CALIFORNIA.

BY J. G. COOPER, M. D.

The long, mostly arid and barren peninsula lying chiefly between the latitudes of 23° and 32° 30′ resembles Florida in barely reaching into the tropics, though, on account of the mountainous character of its interior, only a very narrow strip around the southern and eastern shores may be supposed to be entirely free from frosts.

It differs, however, from all the States of the Union, and also of tropical America in the comparatively scanty rainfall which only approaches abundance to the south of latitude 28° as summer rains, and from 28° to 33° as winter rains, most abundant on the highest and most northern regions. Some of the mountains northward are said to rise to over 10,000 feet elevation. Those of the southern half do not rise above 8,000 as far as known.

The influence of these climatic conditions on the mollusca is shown by the fact that in Florida more than 50 species of terrestrial mollusca occur; in the intermediate State of Texas are over 40, while on the peninsula not more than 24 have been discovered. It is probable, however, that several Californian species will yet be found to extend along the mountain summits farther south than yet known, only three species being so far discovered to inhabit the regions on both sides of the boundary line.

The remaining species are of more tropical groups and mostly peculiar to the peninsula. Only two or three occur also on the main land of Mexico, but what is most remarkable, two species occur also in the similar arid regions of western South America and nowhere in the intervening moist tropical regions. Their supposed migration or transportation from one region to the other has not been explained, but the aid of birds as carriers of their eggs attached to their feet seems the most probable explanation. For full lists and remarks on these regional groups of species I must refer to W. G. Binney's works. My object now is merely to refer to them as showing that although many novelties cannot be expected, the most productive regions near the south coast having been much explored, still there is a large field yet to be visited which may contain new forms. The scarcity of lime seems to be one reason for absence of mollusca in many places.

Mr. Bryant on former collecting trips obtained many of the more northern species. The present small collection picked up as they accidentally occurred between Cape St. Lucas and La Paz, in the extreme south end of the peninsula, shows both the narrow range of some species and how they may be overlooked unless specially searched for.

At Cape St. Lucas and for 100 miles north, the large and important collection of Mr. J. Xantus was made in 1860–61, which furnished four new species of *Bulimulus*, besides the two South American forms. Two others from towards La Paz are also contained in the Academy collection. The Xantus' collection was made during about two years' residence, and extended to Magdalena Bay, but he gives also *B. proteus* Brod., *B. artemisia* and *B. xantusi* Binn., as from Cape St. Lucas.

Mr. J. Xantus (de Vesey) was employed by the U. S. Coast Survey for 18 months, ending July, 1861, as tidal observer at the Cape in 1859–1861, and from the nature of his duties was not permitted to go a day's journey from his post. He claimed in his letters to have gone 350 miles up the west coast, and also to have visited the high mountains about 100 miles inland, besides La Paz, Magdalena Bay, etc. The large collections he obtained were all credited to Lower California and Socorro Islands, but there is a strong suspicion among naturalists that many of them were brought there from the coast of Mexico by vessels and sold to him as being from the peninsula. In this way only can the absence of many of his species from later collections be accounted for. He afterwards collected on the Mexican coast, and may have mixed localities.

SPECIES COLLECTED.

Bulimulus (Mesembrinus) pallidior Sowerby.—"Chili" Pfeiffer ex. coll. of H. Cuming. "Lower California for 350 miles north," W. G. Binney, from Xantus coll. and *fide* P. P. Carpenter, who however quotes it from San Diego also. It is not confirmed as found for 300 miles south of the boundary. The occurrence of this and *B. proteus*, also reported from Lower California as well as Peru or Chili, is made more interesting by the similar occurrence of several plants in both regions which are not found anywhere between.

B. (M.) excelsus Gould. "La Paz" *Xantus*. Also found in that vicinity by L. Belding.

B. (M.) inscendens W. G. Binney, subsp. bryanti J. G. C. "On dry mountains 800 to 1,000 ft. high, between Cape St. Lucas and Margarita Bay, also for three hundred and fifty miles farther north, climbing high Copal trees, never found on the low-lands or table-lands" *Xantus*. Mouth very obliquely expanded, so that the last whorl seems from above to diverge 45° from the axis of shell. Near San José del Cabo, twelve miles east of the Cape, *Bryant*. There seems to be no other difference from Binney's figure and description of this well-marked form. This variation is evidently a more developed growth than that of the typical form, as the largest examples show it most, the projection beyond the outline of shell being in some 0.45 of an inch. It may be analogous to the deflection of upper lip seen in many helicoid shells at maturity, and caused by the weight of shell becoming too great for the animal to support as it did before. This species, in climbing trees has to carry the shell constantly growing spirally, until unable to do so, when the last half inch takes a nearly straight growth. It may be a form limited to the warmer eastern side of the peninsula.

Mr. Bryant obtained twelve examples of this form, two of them living and of a pale brown color, thus proving that it is a permanent local variation instead of being only an individual deformity.

B. (MORMUS) PILULA W. G. Binney. "Todos Santos and Margarita Island" *Xantus*, or 120 miles up the west coast. San José del Cabo, *Bryant*.

A. (MORMUS) SUFFLATUS Gould. "Lower Cal." San José del Cabo to La Paz, *Bryant*. Not found by Xantus.

RHODEA CALIFORNICA Pfeiffer, subsp.? RAMENTOSA J. G. C. The only specimen found is a dead one, which has unfortunately lost some whorls, though there are eight remaining. These are flattened cylindrical, very slightly tapering, imperforate, sculptured by about twelve fine revolving striæ cutting obliquely across close-set riblets, not parallel to lines of growth, producing a file-like surface. Length .60, diam. 1.15 inch. It is most probable that better specimens will prove this to be a distinct species. The mouth is apparently not fully developed. It is very unlike *Cylindrella*, etc.

This is an interesting discovery as probably showing the origin of the specific name, though first described as from Monterey, Cal., and not lately found north of Bogota, New Grenada. It only differs from figures and description in Binney's L. & F. W. Shells, p. 190, in more slender form and sculpture. The figures there given have 10 to 13 whorls.

PHYSA DIAPHANA Tryon. This common Californian species inhabits also a small creek at San José del Cabo, *Bryant*.

NERITINA PICTA Sowerby. With the preceding, and also at Todos Santos creek (L. Belding). (Not place of same name, now generally called Ensenada, near lat. 32°.) Extends to Panama. Neither of these fresh-water shells is given in Carpenter's Catal. of Cape St. Lucas shells.

The marine species collected by Xantus numbered 361, and included all those brought up by the Academy's collectors.

NEW CALIFORNIAN CARICES.

(Notes on Carex, xv.)

BY L. H. BAILEY.

The following new carices are decribed from collections submitted by the California Academy of Sciences:

CAREX OBNUPTA, n. sp.

Intermediate between *C. laciniata*, Boott, and *C. cryptocarpa*, Meyer. Tall and slender, 3–4 feet high, the culm stiff and sharply rough-angled; pistillate spikes about 3, scattered, the lower one or two long-peduncled and drooping, the upper short-peduncled or sessile, all 3 to 5 inches long, evenly and narrowly cylindrical, somewhat loose at the base, mostly prominently staminate at the apex; staminate spikes 2 or 3, considerably or much elevated; perigynium flat and orbicular-obovate, ridged on the edges, nerveless, usually minutely speckled with colored dots, the beak very small and short and minutely erose or entire, about the length of and twice or more broader than the thin and black-purple white-nerved sharp or bluntish scale.—San Mateo Co., *Kellogg;* Sierra Nevada (Donner), *Kellogg & Brannan;* Fort Point, San Francisco, *Bolander*.

This species lacks the stiff habit of growth of *C. laciniata*, as well as the laciniate scale and toothed, tapering perigynium, while the perigynium and short scale are wholly different from those of *C. cryptocarpa*. With the exception of the short scales the spikes of *C. obnupta* are very like those of *C. crinita* in appearance.

CAREX QUADRIFIDA, n. sp.

C. atrata, Linn., var. *erecta*,* W. Boott, Bot. Calif., ii, 239, at least mostly.

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* *C. erecta* has been before used in the genus.

Allied to *C. fusca*, All. Tall and stiff, 2 to 3 feet high, the culm smooth or nearly so: spikes usually 5, ½ to 1½ inches long, compact, the lowest one 2 to 4 inches, remote and short peduncled, the others usually shorter or more or less aggregated into a somewhat quadrifid head and sessile, or very nearly so, some of them often nearly globular, the terminal one staminate below for a-half or third its length; perigynium flat, obovate, splashed with purple, but the edges usually light-colored, nerveless, very abruptly rounded into a short and very slender erose beak, mostly longer and always broader than the purple and white-nerved sharp scale.—Mt. Dana, *Bolander*, 5046; *Brewer*, 1773.

Var. LENIS, n. var.

Usually lower, more slender, the leaves softer and more grass-like; perigynium white or nearly so throughout, usually minutely pitted, and the spikes shorter, often all nearly globular.—*Bolander*, 5046; *Kellogg & Harford*, 1080; Donner, *Kellogg*.

CAREX MONILE, Tuckm., var. PACIFICA, n. var.

C. vesicaria, W. Boot. Bot. Calif., ii, 252.

Leaves broad; spikes thick and short, 1½ inches or less long; perigynium very thin, strongly few-nerved, tapering, shining at maturity, 3 or more times longer than the thin and brownish obtuse or muticous scale.—*Brewer*, 1654; Donner, *Brandegee*.

A careful study of the American and European plants convinces me that they are distinct, and that *C*, *vesicaria*, Linn., does not occur in this country. *C. monile* var. *Pacifica*, to which I have referred all that has been called *C. vesicaria* in this country, differs from *C. vesicaria*, among other things, in its much stronger nerved perigynium which is more tapering in shape, and by its much shorter and blunt scales. This disposition greatly simplifies the study of our American *Vesicariæ*. *C. monile* is to America what *C. Vesicaria* is to Europe, but probably varying into more forms in its great range. Bœckeler (Linnæa xli. 319) unites *C. monile* with *C. vesicaria*, but there are differences enough to separate them, and their union would lead to great confusion.

I am unable to determine positively from the material I have examined if *C. monile* itself occurs in California. The *C. monile* of Bot. Calif., ii, 251, is certainly var. *colorata* Bailey (Bolander, 6211, v. s. Hb. Gray.) In the collection of the California Academy of Sciences are specimens referable to this variety. *Bolander*, 6200, from the Yosemite, referred by W. Boott. to *C. vesicaria* in Bot. Calif. is somewhat intermediate, but is evidently the variety *colorata*.

A NEW VOLUTOID SHELL FROM MONTEREY BAY.

BY J. J. RIVERS.

SCAPHELLA (VOLUTA) ARNHEIMI.

Shell regularly formed, elongate-ovate; body whorl more than two-thirds as long as the spire; the spire an inch long, and made up of six whorls, the terminal nucleus being very small, pointed and oblique, which latter character places this species in the section *Scaphella* of Dall.

Ground color obscure yellow, covered by a layer of chalk-like deposit. The body whorl has some coarse longitudinal elevations and depressions, remnants of former lip extensions, and there are two large patches of dark rusty red at a wide interval which do not appear to form an interrupted band. The aperture is elegantly formed and measures 1⅞ inches long by ⅞ inch wide; the inner lip is regularly outlined on the columella; columella plaits four, sharply oblique, the last one strongest, forming a prominent ridge parallel to the canal. The upper outlines of the mouth meet in a sharp angle, but the base has a well defined bifurcation. The whole of the aperture and the edge of the outer lip are heavily coated with enamel of a yellowish tint, and rust stained. Size 3⅛ inches long and 1⅛ wide. Animal without operculum.

Dredged in Monterey Bay, California.

FLORA OF THE CAPE REGION OF BAJA CALIFORNIA.

BY T. S. BRANDEGEE.

By the "Cape Region" is meant that part of the peninsula south of a line drawn along the northern base of the mountains from Todos Santos to La Paz. This region is mostly hilly or mountainous, with few broad valleys or level areas. The highest peaks are in the central portion, and most of them have the appearance of isolated cones rising sharply from the rough elevated region surrounding them. The largest valley is that of the Rio San José, which empties into the ocean at San José del Cabo. This valley supports several villages, and some of its tributary cañons are occupied by cattle ranches. In fact throughout this region the valleys and cañons, however small, are occupied, wherever unfailing water is found, by one or more families who irrigate small patches of ground, and look after their flocks of goats and their cattle.

The mountain peaks, according to the maps of the Coast Survey, reach a height of six thousand feet above sea level. Their tops during the rainy season (June–October) are enveloped in clouds, and thunder storms are of frequent occurrence. Running water can be found in the larger cañons throughout the year, but it usually disappears in the sand soon after reaching the foothills. The Rio San José contains water during the whole year and several species of fresh water fish inhabit it, but in most of the water courses, even when twenty or thirty miles long, no running water excepting near their sources was seen at the close of the rainy season.

The Tropic of Cancer runs through Todos Santos and the climate is necessarily a warm one, but tempered by the sea and the high mountains the heat is not so great or so enervating as might be expected. Even in midsummer the nights are moderately cool, and in the winter light frosts occasionally occur in the high mountains.

This mountainous region of the Cape is separated from the nearest mountain to the north by a wide extent of level country, and the trail from Todos Santos to La Paz passes over a district apparently seldom if ever more than a hundred and fifty feet above the level of the sea. The most northern peak of the Cape Region, La Aguja (The Needle), 5,900 feet in height, is separated by a distance of more than a hundred miles from the nearest of the northern high mountains.

The Cape Region is, therefore, an isolated region of mountains of considerable elevation, separated from those of the north by nearly two degrees of intervening lowland, and from the nearest mainland coast by a hundred miles of sea, and the flora of a region thus situated may be expected to, and does, show marked differences in forms from its nearest neighbors.

The list of plants given below is mainly the result of two trips made by the writer in 1890; the first was in January and February from the landing at Magdalena Bay, down the coast on horseback to Todos Santos, from there making an excursion to the Sierra de la Laguna and returning, and thence to La Paz.

This trip was undertaken at an unfavorable season of the year, nearly all the annual plants excepting in irrigated fields, or high mountain valleys, having dried up and disappeared, after the September rains.

The second trip made in company with Walter E. Bryant, sent out by the California Academy of Sciences to examine the fauna of the region, occupied the months of September and October, with San José del Cabo as a base of operations. The plants about that place were thoroughly collected during September and part of October, at a season when abundant rains had produced luxuriant growth. From San José a collecting trip was made along the eastern base of the mountains and across their western spur, through the mining town of Triumfo to La Paz. Very little rain had fallen in the region between these last places and few additions were, in consequence, made to those already found, but during the journey a short "side trip" into the higher mountains was made from Agua Caliente, and in a few days time the most interesting portion of the collection was obtained.

Few and scanty collections of plants from the Cape Region have been made previous to these trips, and nearly all the species formerly obtained have been re-collected.

The Cape St. Lucas collection of the Sulphur contained less than twenty species; one hundred and twenty-one are enumerated by Dr. Gray in the Xantus collection made in 1859–60; and a few were collected by W. J. Fisher and others connected with the Coast Survey.

Mr. L. Belding, while engaged in studying the avifauna in 1885, made a small collection including *Nolina Beldingii* and the type of a new Scrophulariaceous genus, *Clevelandia;* and Dr. Palmer during the time of the writer's Todos Santos trip made a collection of a hundred and fifty species at La Paz.

The Flora of the coast is subtropical, and a considerable proportion West Indian, many of the plants perhaps introduced; that of the elevated regions is largely Sonoran.

1. CLEMATIS, sp. Common in the hedges of irrigated fields and damp localities, between Miraflores and Triumfo. One plant only was found in bloom and that bore staminate flowers. It may be *Clematis Drummondii* T. & G.

2. THALICTRUM, sp. Found with remains of mature fruit which somewhat resembles that of *T. Hernandezii*. Common in wet places about the mountain tops. It is probably an undescribed species.

3. RANUNCULUS, sp. Past flowering and with only a single mature seed. The radical leaves are long-petioled, entire, round-reniform and doubly serrate, the heads apparently small.—Damp places on the summits of the high mountains.

4. ARGEMONE MEXICANA L.—Todos Santos, La Paz, San José del Cabo.

5. NASTURTIUM OFFICINALE R. Br.—Streams of the Sierra de la Laguna.

6. SISYMBRIUM CRENATUM.—Annual, glabrous, ½–1 m. high, branching above; lower leaves triangular-acuminate, entire or sinuate-dentate, cuneate at base, 2–4 cm. long on petioles of nearly the same length, upper leaves linear-lanceolate, entire or sparingly dentate; racemes 1½ dm. long; sepals greenish, the outer ones convex and saccate at base; petals white 5–6 mm. long, spatulate in outline, about 9-lobed, shortly clawed and twice exceeding the sepals; filaments subulate, tomentose at base much shorter than the petals: stigma capitate; pod cylindrical, short stipitate, very slender, about 10 mm. long, equaling the pedicel, 8-14 seeded; valves indistinctly 1-nerved, seeds in one row, oblong, cylindrical; cotyledons broad, incumbent somewhat enfolding the radicle.

This plant differs from the genus in which it is placed by having lobed petals, a peculiarity not common in Cruciferæ. Although the genus Dryopetalum rests mainly upon its lobed petals and this character is a distinguishing one of Schizopetalon it does not seem best to make a new genus for this plant, even though slight characters have great weight in the order.—Common at low elevations of the Sierra de la Laguna.

7. Cardamine Palmeri Watson. Collected by Dr. Palmer at La Paz.

8. Lyrocarpa Xanti Brandegee.—Throughout the whole Cape Region at low elevations.

9. Lepidium nitidum Nutt. Sierra de San Francisquito.

10. Lepidium Virginicum L. Sierra de San Francisquito.

11. Atamisquea emarginata Miers. Not so abundant as in the region about San Gregorio.

Some specimens have recently been received from Dr. F. Kurtz, Cordoba, Argentine Republic. He writes: "I enclose two specimens of our *Atamisquea*—the most detestable shrub I know—brittle like glass and ill-smelling." The differences in floral structure noted in Proc. Cal. Acad., ser. 2, ii, 128, may to some appear sufficient to justify the separation of the North American forms as a variety or even a distinct species.

12. Cleome (Physostemon) ephemera.—Annual, glabrous, erect, branching from the base, 2–3 dm. high; leaves simple, linear, acuminate, 2–3 cm. long; flowers solitary from the upper axils, yellow, 5 mm. long; petals oval, tapering to the base, crenate-dentate, twice longer than the linear-lanceolate sepals; stamens 8, four perfect, four with golden yellow inflations below the sterile anthers; ovary very shortly stipitate, 20-ovuled; style short, stigma capitate; capsule 2 mm. wide, 2–2½ cm. long, on a filiform pedicel of nearly the same length; seeds muricate.

Very abundant about San José del Cabo during the rainy season and soon disappearing when the soil becomes dry.

13. Cleome tenuis Watson. The leaves, differing from the five-leaved forms of Guaymas, are usually nearly all trifoliolate.—San José del Cabo.

14. Wislizenia refracta Engelm. Very abundant on the saline flats about La Paz.

15. Helianthemum glomeratum Lag. High mountains of the Sierra de la Laguna.

16. Lechea Drummondii T. & G.?—Summits of the high mountains of the interior. Stamens 3; outer sepals longer than the capsule.

17. Ionidium fruticulosum Benth. Perennial.—Todos Santos, La Paz, San José del Cabo.

18. Ionidium riparium HBK. Annual, puberulent; flowers solitary, ochroleucous; petals nearly equal.—Common about San José del Cabo.

19. Amoreuxia Wrightii Gray. Single specimen 3½ dm. high with perfectly ripe fruit. Capsules 50–55 cm. long, pubescent with many longitudital veins, which are prominent internally; the whole plant marked by minute red often linear punctæ. Capsule much more acuminate than in the published plate, pl. Wright 3. The stout somewhat sigmoid peduncle is deflexed; the ovules, of which very many are abortive, are in several rows in each cell; the seeds exactly globular, about 5 mm. in diameter, dark brown, the arilliform outer covering minutely wrinkled, closely conformed, sparsely covered with white hairs, and marked by a linear elevated raphe which extends from the micropyle to the chalaza, ⅓ the circumference of the seed; the testa is smooth and shining, thick and hard, perforated at the micropyle, the opening filled by a conical obturator, brown tipped with white, nearly 1 mm. long, visible as a white spot on the surface; tegmen light brown, not separable from the endosperm.

20. POLYGALA BERLANDIERI Watson.—Sierra de San Francisquito.

21. POLYGALA XANTI Gray.—Todos Santos, San José del Cabo. Zoe i, 271.

22. POLYGALA PUBERULA Gray.—Collected by Xantus. Proc. Am. Acad. v, 154.

23. POLYGALA APOPETALA Brandegee.—San Bartolomé Cañon, Sierra de la Laguna. Zoe i, 4.

24. KRAMERIA CANESCENS Gray, var. *pauciflora* Rose. Contr. U. S. Herb. iii, 66.—Abundant between Todos Santos and La Paz.

25. KRAMERIA PARVIFOLIA Benth.—San José del Cabo.

26. SILENE LACINIATA Cav. A form with broad oblanceolate lower leaves and the outer divisions of the limb much smaller than the inner. The scales are broad and more or less lobed.—Sierra de la Laguna, Sierra de San Francisquito.

27. STELLARIA CUSPIDATA Willd.—At high altitudes along streams of the Sierra de la Laguna. Considered a synonym of *S. nemorum* L. in Biolog. Central. Mex. 68.

28. ARENARIA ALSINOIDES Willd. Forms with and without petals.—High altitudes of the mountains.

29. SAGINA LINNÆI Presl.—Sierra de la Laguna.

30. DRYMARIA ARENARIOIDES Willd. mentioned by Dr. Gray under *D. frankenioides*,* was collected by Xantus at the Cape.

31. DRYMARIA HOLOSTEOIDES† Benth. San José del Cabo.

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* Proc. Am. Acad. v, 154. † Zoe ii, 68–70.

32. Drymaria crassifolia † Benth.—San José del Cabo, La Paz.

33. Drymaria Fendleri Watson.—Sierra de la Laguna.

34. Drymaria carinata Brandegee, Zoe ii, 70.—Sierra de la Laguna.

35. Drymaria polystachya Brandegee, Zoe ii, 70. San José del Cabo.

36. Paronychia monandra. Perennial, prostrate: branches 3–5 mm. long, with short lateral crowded branchlets: leaves opposite linear, pubescent, narrowed at base and setosely acuminate; stipules ovate-acuminate, ciliate, nearly as long as the leaves: perianth pedicellate, pubescent, segments oblong linear, somewhat cucullate, with a minute dorsal spine: stamen solitary; filament very short, subulate: staminodia none: stigma very short, minutely 2-lobed; seed globose, large; testa smooth; funicle long; radicle lateral.

This plant bears a very considerable resemblance to the familiar *Pentacæna ramosissima*. In the number of stamens it does not agree generically with *Paronychia* and the position of the radicle is unusual, but it seems better to place it here than on such slight grounds make a new genus.

37. Portulaca oleracea L.—growing in the gardens about San José del Cabo and in the gulches during the rainy season.

38. Portulaca lanceolata Engelm.—Not uncommon on the mesas and hills about San José del Cabo during the rainy season. It is usually erect and the color and size of the flowers are variable. The petals are

†Zoe ii, 68–70. Dr. Sereno Watson has since written me that a part of the type in the Harvard Herbarium is as pubescent as the preceding species.

usually brick red at their edges, becoming yellow in the center.

39. PORTULACA STELLIFORMIS, Mocino & Sesse. The size of the flowers is very variable, they are commonly about three-quarters of an inch in diameter.—San José del Cabo and La Paz, growing upon hillsides.

40. PORTULACA PILOSA, L.—Petals small, purple and mucronate, not retuse as described by Dr. Gray, otherwise it seems to agree with the descriptions and specimens of this species. This plant is very abundant in sandy soil throughout the Cape Region.

41. PORTULACA PARVULA, Gray. Petals small, yellow.—Common in the region about Agua Caliente.

42. TALINUM TRIANGULARE W.? In the shade of cliffs near Miraflores.

43. TALINUM PATENS Willd.? Flowers purple with yellow center, in ample paniculate racemes; the root is tuberiform, 2–3 cm. thick and 8–10 cm. long.—Common in the hills about San José del Cabo.

44. FOUQUIERIA SPINOSA Torr. Throughout the whole region excepting the high mountains.

45. HYPERICUM ANAGALLOIDES Cham. & Schlecht.—Sierra de la Laguna.

46. HYPERICUM, sp. A perennial species common in the high mountains.

47. ANODA ACERIFOLIA DC.—Miraflores.

48. ANODA LANCEOLATA H. & A. Agreeing sufficiently well with this species. Flowers yellow with purple centers.—Sierras of the interior.

49. ANODA CRENATIFLORA Ort.? This seems to be the same as the plant collected at Comondu and doubtfully referred to *A. crenatiflora*. The pubescence and

structure of the fruit is exactly that of the northern forms, but the plants are much larger and afford great variations in the leaves, some of which are cordate at base, 10 cm. long and 8 cm. wide, irregularly dentate, more or less 3–5 lobed. The upper ones are divided nearly to the base and the uppermost narrowly linear. — Common about San José del Cabo.

50. Sida hederacea Torr.—San José del Cabo.

51. Sida Xanti Gray.—Common, Todos Santos, La Paz, San José del Cabo.

52. Sida diffusa HBK. Entirely without pilose hairs, but apparently otherwise the same.—Miraflores.

53. Sida rhombifolia L.—Todos Santos, San José del Cabo. Common in cultivated fields.

54. Abutilon incanum Don.—San José del Cabo, La Paz, Todos Santos.

55. Abutilon Palmeri Gray.—La Paz, Todos Santos.

56. Abutilon Californicum Benth.—San José del Cabo.

57. Abutilon Xanti Gray. Proc. Am. Acad. xxii, 301. A fine large species abundant between San José del Cabo and Triumfo. The color of the flowers in the living plants is so light a yellow as to appear almost white, but in the dried specimens it changes to a decided yellow. The stems are simple and in some locations become 10–12 feet tall, with leaves six inches wide and eight inches long on petioles half a foot in length. The seeds are scabrous.

58. Abutilon crispum Don. Fine large plants growing about the cultivated fields of San José del Cabo.

59. Sphæralcea incana Torr.? In flower only and

doubtless the same as the one referred to this species by Dr. Gray in the list of the Xantus collection.

60. Sphæralcea Californica Rose. Contribution U. S. Herb. iii, 66.—La Paz. Except in damp soil and low lands the plants are small and soon disappear.

61. Kosteletzkya Coulteri Gray. San José del Cabo. Only a single plant seen, the flowers become green in drying, seeds pubescent with simple hooked hairs. The species are apparently all very nearly related.

62. Hibiscus Coulteri Gray.—San José del Cabo, La Paz.

63. Hibiscus ribifolius Gray. This species grows to a height of eight feet; the flowers larger than those of *H. Coulteri* are sulphur yellow in color; the leaves and stems are either glabrous or pubescent; the petals are sparingly stellate-pubescent, and variable in form.—Todos Santos, San José del Cabo.

64. Gossypium Davidsoni Kellogg.—San José del Cabo.

65. Gossypium, sp.—A cultivated species escaped from cultivation at San José del Cabo.

66. Horsfordia Palmeri Watson.—La Paz, San Pedro.

67. Horsfordia rotundifolia Watson. *H. Purisimæ* Brandegee, is probably the same. Zoe i, 253.—La Paz.

68. Hermannia Palmeri Rose.—Common. La Paz, Todos Santos, San José del Cabo.

69. Melochia tomentosa L. Common everywhere except in the mountains.

70. Melochia pyramidata L.—Triumfo.

71. Waltheria detonsa Gray.—Todos Santos, San José del Cabo.

72. Ayenia pusilla L.? San José del Cabo. The same as the plant collected about Magdalena Bay.

73. Ayenia Berlandieri Watson. San José del Cabo.

74. Triumfetta semitrilola L.—Santa Catarina, Miraflores.

75. Malpighia Galeottiana Ad. Juss.? "Manzanita." A bush common about San José del Cabo.

76. Galphimia angustifolia Beth var.—San José del Cabo, La Paz.

77. Janusia Californica Benth.—San José del Cabo, La Paz.

78. Tribulus grandiflorus Benth. & Hook.—Common about San José del Cabo.

79. Tribulus maximus L. Rancho Colorado, San José del Cabo.

80. Tribulus Californicus Watson.—Very abundant about San José del Cabo.

81. Fagonia Californica Benth.—San José del Cabo. Not common.

82. Larrea Mexicana Moric.—Todos Santos, La Paz.

83. Guaicum sanctum L.? A small bush, its leaves having only one or two pairs of oblique, mucronate leaflets. The flowers are blue and the fruit usually mucronate.—Not common. San Jósé del Cabo.

84. Viscainoa geniculata (Kell.) Not so abundant as in the region about San Ignacio and no pinnate-leaved forms like those in the central, have been seen in the Cape Region.—La Paz, Todos Santos, San José del Cabo.

Engler in Pflanzenfamilien iii Teil, Abt. 4, 88, describes Viscainoa as 5-merous. In this he is certainly in error, or misled by an unusual example. The notices in Proc. Cal. Acad., ser. 2, i, 228 and ii, 137, drawn from abundant material, have apparently been overlooked. The flowers though varying from 3–6 are ordinarily 4-merous, the stamens nearly always 8. The leaves vary from 1 to 5-foliolate.

85. Geranium Carolinianum L.—Sierra de la Laguna.

86. Oxalis corniculita L.—Common in the high mountain regions.

87. Xanthoxylum Fagara (L.) Miraflores, Sierra de la Laguna.

88. Xanthoxylum Caribæum Lam.? Some of the specimens are spinose. The young growth is pubescent.—Not uncommon. San José del Cabo, San Bartholomé, Sierra de la Laguna.

89. Esenbeckia flava Brandegee. Zoe 1, 378, pl. xii.

90. Castela tortuosa Liebm. Very abundant near the coast throughout the whole region. The male flowers are not sessile, but are more shortly pedicellate than the female; the anthers are 6–10, usually 8. The style falls as a whole, and the branches are united at the base—at least in most cases.

91. Bursera fagarioides Engler. *B. odorata*, Brandegee. Common throughout the whole region. Specimens from San José del Cabo have leaves with either crenate or entire margins.

92. Bursera microphylla Gray. Very abundant between Santiago and Buena Vista near the sea shore, and more or less abundant everywhere except on the high

mountains. About Buena Vista the bark has been cut from the trunks and larger limbs of the trees and exported for tanning purposes. The trees do not die, for the cutting is not deep enough and the bark is not completely removed.

93. BURSERA HINDSIANA (Benth.) — San José del Cabo. Forms with simple leaves only.

94. BURSERA LAXIFLORA Watson. This seems to be one of the most variable species in regard to its foliage and but for the forms from San José del Cabo that approach so closely *B. laxiflora* collected at Guaymas by Dr. Palmer, it would be considered a distinct species. The bushes near La Paz growing upon the low sand beach opposite the town bear simply pinnate, densely white-pubescent small leaves; trees from the interior and Todos Santos have large, sometimes very pubescent leaves, with the larger ones more or less doubly pinnate. The Cape specimens have longer and narrower leaves, with the leaflets more distant and appear to be the same as Dr. Palmer's Guaymas specimens; they are not as handsome as the more northern forms with pubescent fern-like leaves. An acquaintance with this tree throughout a large extent of country convinces me that the forms belong to one species. It is found as far northward as the low region opposite Santa Margarita Island.

95. BURSERA CERASIFOLIA. A bush or small tree, 4–5 m. high, branched from the base, glabrous; leaves simple, sessile, crowded at the ends of the branchlets, ovate-lanceolate, 4–6 cm. long, 1-2 cm. wide, slightly crenate, thin in texture, with numerous veins nearly at right angles with the midrib; peduncles apparently terminal but really from the axils of the leaves, slender and exceeding them, 1-3 flowered; sepals 4, unequal, subulate or del-

toid, 1 mm. long, 1/3 the length of the petals; stamens 8; fruit obovate, narrowed at base, 6 mm. long; seed black at top covered below with an orange colored arillus.—San José del Cabo.

96. SCHŒPFIA CALIFORNICA Brandegee. Not so abundant as about San Gregorio.

97. MAYTENUS PHYLLANTHOIDES Benth.—La Paz, San José del Cabo.

98. KARWINSKIA HUMBOLDTIANA Zucc. Common. La Paz, Todos Santos, San José del Cabo.

99. COLUBRINA GLABRA Watson.—San José del Cabo.

100. CONDALIA MEXICANA Schl.—Not uncommon.

101. GOUANIA TOMENTOSA Jacq.? Probably this species. The specimens vary much in their pubescence and the leaves are cordate or cuneate at base, acuminate or emarginate. The fruit is densely villous-pubescent and its wing hardly equals the cell in width, but it is somewhat immature and they might increase in size.—San José del Cabo.

102. VITIS, sp. Leaves only of a species common in the mountains. The fruit is used for making a native wine.

103. VITIS (*Cissus*) ACIDA.? Todos Santos.

104. VITIS (*Cissus*) sp. Miraflores.

105. CARDIOSPERMUM HALICACABUM L. Common at low elevations, and running into many diversities of foliage, pubescence and trivial differences of petal scales and glands.

105½. CARDIOSPERMUM PALMERI Rose. La Paz, and also from Socorro Island.* *C. Loxense* to which it is said

* Proc. U. S. Nat. Mus., xiii, 147.

to be allied was reduced by Grisebach † along with *C. molle* and others to *C. Halicacabum*.

106. PAULLINIA TORTUOSA (Benth., under *Cardiospermum*). Zoe, ii, 74. This plant is a Paullinia, having 5 sepals, four glands and a septicidal capsule, nearly filled by the large seed; arillus deeply crescentic; leaves deeply impressed over the veinlets on the under surface, and minutely papillose on the upper. The two anterior glands are conical, lobes of the stigma elongated.

107. PAULLINIA, sp. A much stiffer plant with ternate leaves more or less punctate and impressed in lines; terminal leaflet much the larger, all 3-lobed and more or less crenate-dentate; arillus lunate; fruit nearly as in the last. The flowers are somewhat smaller and the glands much less conspicuous, but fuller material is needed to determine whether it is specifically distinct.—La Paz, also collected (No. 23) by Dr. Palmer at the same place.

108. PAULLINIA SONORENSIS Watson? Fruit somewhat larger than described. The leaves are in texture and pubescence much like *P. tortuosa*, the glands are oblong and rather prominent, seed usually solitary, aril circular.—San José del Cabo.

109. PAULLINIA, sp. More than one species may be embraced in the specimens, which vary from pinnately 5-foliolate forms with very large leaflets, oval or ovate, crenate-dentate, 4–5 dm. long, to others with the lower pair 3-parted, and all deeply incised, the pubescence not very dense, and the upper surface somewhat punctate-scabrous. The capsule is large and pyriform 20–25 mm. in diameter rather densely pubescent; seeds usually 2, 8-13 mm. in diameter, basal area bilobed; peduncles as long as the leaves 5–8 dm. long; flowers numerous; glands

†Flora of the British West Indian Islands, 122.

rather small ovate; style stout with 3, minutely bi-lobed stigmas.—Miraflores, Agua Caliente, San José del Cabo. Possibly an undescribed species but it requires considerable temerity in the present state of the genus to venture on naming new species. A single imperfect specimen from the seashore at San José del Cabo has smaller, somewhat coriaceous, almost glabrous leaves.

110. Dodonæa viscosa L. Not uncommon. Broader leaved than the Chihuahua specimens.

111. Rhus sempervirens Scheele. Engler's Anacardiaceæ, 390. A spreading bush, eight feet high.—Sierra de la Laguna in fruit. Sierra de San Francisquito in flower.

112. Rhus laurina Nutt.—Sierra de San Francisquito. A very small bush and not abundant.

113. Cyrtocarpa procera Engler. A small tree, common throughout the region, bearing gray-pubescent pinnate leaves and a yellow, acid fruit. On some trees the fruit is pleasant to the taste and on others bitter and disagreeable. The fruit, known as "ciruela" (plum) was ripe in August and no young flowers could be found but the sepals, petals and stamens persist at the base and these agree with Engler's figure. The leaves are half the size of those described, otherwise there seems to be no difference.

114. Crotalaria incana L. Sierra de la Laguna. San José del Cabo.

115. Crotalaria pumila Ortega.—San José del Cabo.

116. Crotalaria sagittalis L.—San José del Cabo in the sand of stream beds and common in the Sierra de San Francisquito.

117. Lupinus, sp. A handsome species, the same as

one common in the central part of the peninsula. Abundant in the high mountains. It may be a form of *L. Arizonicus*.

118. MELILOTUS PARVIFOLIA Desf. San José del Cabo.

119. TRIFOLIUM INVOLUCRATUM Willd.—Sierra de la Laguna.

120. HOSACKIA GLABRA Torrey.—Sierra de la Laguna.

121. HOSACKIA RIGIDA Benth. Often prostrate. Apparently a reduced form of this species. Sierra de la Laguna under the pines and oaks.

122. PSORALEA RHOMBIFOLIA T. & G. Teeth of the calyx more nearly equal than those of Texas specimens but otherwise the same.—Sierra de San Francisquito.

123. DALEA EMORYI Gray.—Abundant near La Paz.

124. DALEA MARITIMA. Perennial, branching, nearly prostrate, silky pubescent: heads 2–3 cm. long terminating the branches or apparently lateral: leaves 2½ cm. long; leaflets 8–11 pairs, sparingly glandular, 3 mm. long, oblong-ovate, stipellate; stipules small subulate: calyx 2 mm. long, furnished with large glands, prominently ribbed, equaling the linear-lanceolate bracts, glabrous excepting the silky-ciliate teeth which are shorter than the tube: corolla purple, twice the length of the calyx: anthers glandless: ovary and pod glabrous, beset by four rows of glands; ovules two.

Growing in the sand of the ocean beach, just above high water mark, at Todos Santos and La Paz. The stems and branches of the Todos Santos specimens are densely white silky and the numerous black glands so conspicuous on the La Paz plants are completely hidden. Collected also by Dr. Palmer at La Paz.

125. DALEA DIVARICATA Benth.—Sierra de la Laguna.

126. DALEA CHRYSORHIZA Gray. Common.—Todos Santos, Sierra de la Laguna, San José del Cabo, La Paz.

127. DALEA RAMOSISSIMA Benth. — Sierra de la Laguna.

128. DALEA CANESCENS Benth. Much less pubescent than the Magdalena Bay specimens, glands minute and sparse, flowers smaller, the vexillum much broader than long and somewhat 3-lobed with the middle lobe triangular.—La Paz.

129. DALEA, sp. Frutescent, spreading, with stems 2–3 feet long.—San José del Cabo.

130. INDIGOFERA ANIL L.—Todos Santos, San José del Cabo.

131. INDIGOFERA, sp. Frutescent, four feet tall with racemes much longer than the leaves.—San José del Cabo.

132. TEPHROSIA PALMERI Watson.—About San José del Cabo the flowers are ochroleucous. *T. Purisimæ* Brandegee, described from more northern forms having purple flowers, is probably this species.

133. TEPHROSIA TENELLA Gray.—La Paz, San José del Cabo.

134. TEPHROSIA CONSTRICTA Watson.—San José del Cabo.

135. TEPHROSIA CANA. Herbaceous from a woody base, 6–9 dm. high, whole plant appressed silvery pubescent: leaves 8–15 cm. long; stipules deflexed, rigid but not spinescent; leaflets 5–8 pairs, 3–8 cm. long, oblong elliptic, veins parallel, petiolules bent angularly: racemes elongated, naked below terminal or axillary: pedicels

shorter than the flowers, bracteate at base, and with two broad bracteoles at summit: calyx broadly campanulate 6–8 mm. long, the broad acuminate lobes twice the length of the tube, the two upper high-connate: corolla more than twice the length of the ochroleucous or sometimes purplish corolla: vexillary stamen free for its whole length even in the bud, with a prominent angular callosity near the base; anthers uniform: style flattened bearded on the upper side, penicillate at apex: pod flattened 6–8 cm. long, 4 mm. wide: seeds oblong, flattened, 5 mm. long, 3 mm. wide; cotyledons of the solitary perfect one deeply constricted at the middle; radicle incurved, half their length. High Sierras—Sierra de la Laguna and Sierra de San Francisquito.

136. Coursetia glandulosa Gray. — Miraflores, La Paz.

137. Cracca Edwardsii Gray. — Miraflores, San Pedro, Sierra de la Laguna. The mountain plants are about a foot high, and bear small very silky pubescent leaves: the Miraflores plants are three feet high, with the old leaves nearly glabrous, almost an inch long and pods two to three inches long, 24-seeded.

138. Sesbania macrocarpa Muhl.—Rancho Salado, and very abundant about San José del Cabo.

139. Astralagus, sp. Differing from *A. obscurus*, Watson, very slightly: the habit is more prostrate, the stipules more foliaceous and the keel a little more beaked. As it seems to grow only about the two deserted ranches of the high mountains it is probably an introduced plant. Sierra de la Laguna, Sierra de San Francisquito.

140. Nissolia setosa. A branching vine, 3–4 mm. high, supported or twining on small trees, sparingly hirsute: leaflets 5, orbicular, obtuse or retuse, mucronate,

1–2 cm. long, on petiolules 2 mm. long, glabrous; stipules linear 3–4 mm. long, persistent: flowers 4 mm. long, dark yellow; calyx teeth longer than the tube, 3 mm. in length including the terminal, long, yellowish, bristly awn: fruit 1–2 jointed, pubescent and sparingly beset with long yellow bristles which are brown and glanduliform at base, the wing slightly curved, 1 cm. long; pedicels 5 mm. long.—Triumfo to San Pedro.

141. ÆSCHYNOMENE NIVEA Brandegee.—Todos Santos, La Paz.

142. ÆSCHYNOMENE VIGIL. Shrubby, about 1 m. high with white branching stems, whole plant appressed-pubescent: leaves not sensitive; pinnæ 5–7 pairs, oblong, mucronate, 8–12 mm. long, rather rigid; stipules persistent, lanceolate-acuminate, striate: flowers purple, solitary or few in the axils; pedicels 7–10 mm. long, sparingly covered with hair bearing glands: calyx 2-bracteolate, the lower sepal much longer, the other four about equaling the tube: corolla purple, more than twice the length of the calyx: ovary pubescent; legume 2–3-articulate.—San José del Cabo.

143. STYLOSANTHES VISCOSA Lee.—Common about San José del Cabo.

144. ZORNIA DIPHYLLA Pers. Perennial.—Agua Caliente, Sierra de San Francisquito.

145. DESMODIUM NEO-MEXICANUM Gray. Various forms, some with nearly all the leaves simple and broadly deltoid. Common.—San José del Cabo, Miraflores.

146. DESMODIUM SCOPULORUM Watson.—San José del Cabo.

147. DESMODIUM (HETEROLOMA) PROSTRATUM. Herbaceous, perennial, prostrate; stems 1 m. long covered with uncinate hairs: leaves on petioles 5–8 cm. long,

pubescent with long white silky hairs; leaflets 3, orbicular, mucronate, 3–6 cm. broad, 3½–6½ cm. long, the lateral one truncate at base, the terminal one somewhat larger and cuneate at base; stipules persistent, large, overlapping at base, acuminate, 10–18 mm. long, 5–8 mm. wide at base; stipels lanceolate, 8 mm. long: racemes axillary and terminal: calyx lobes deltoid-lanceolate: corolla purple, 10–12 mm. long: bracts soon deciduous, broadly ovate, rather abruptly acuminate, 5–6 mm. long: pod 2½ cm. long, 5–6 jointed, lobed slightly upon the ventral side and to the center on the dorsal, thickly beset with short uncinate yellowish hairs.

A common species at high elevations in the mountains. The prostrate stems spread in all directions from a perennial root; the leaflets are crowded at the end of the petiole, the stipe of the terminal one being only 1 cm. long. It somewhat resembles *D. strobilaceum*.

148. DESMODIUM SCORPIURUS Desv.—Probably introduced.—San José del Cabo.

149. DESMODIUM WISLIZENI Engelm. Old specimens without fruit from the Sierra de la Laguna.

150. DESMODIUM SPIRALE DC.—Miraflores.

151. DESMODIUM, sp. Santa Catarina.

152. DESMODIUM, sp. Sierra de San Francisquito.

153. DESMODIUM, sp. Sierra de San Francisquito.

154. DESMODIUM, sp. Miraflores.

155. DESMODIUM, sp. Miraflores.

156. CLITORIA MARIANA L.—Sierra de San Francisquito.

157. ERYTHRINA CORALLODENDRON L. In fruit only and the species uncertain. A small tree common about San José del Cabo and Todos Santos. Known as "coralina." The boys play with the large red seeds in the

same manner that the boys of Alta California do with the seeds of Megarrhiza, and they call them by the same name: "chilacayote."

158. GALACTIA TENUIFLORA Willd.—Miraflores.

159. PHASEOLUS, sp.—Fields at Miraflores.

160. PHASEOLUS FILIFORMIS Benth.—San José del Cabo.

161. PHASEOLUS ATROPURPUREUS DC. Common.

162. PHASEOLUS MONTANUS. Annual, twining; stems ½ m. long, minutely retrorsely scabrous: petiole shorter than the leaflets; leaflets linear-lanceolate, rugosely veined, scabrous, the terminal one 6 cm. long or less, 4 mm. wide, the lateral ones somewhat smaller; stipules lanceolate, striate, 2 mm. long: peduncles little shorter than the leaves, 1–2 flowered: flowers yellow or ochroleucous, small: calyx 4-toothed, tube 2 mm. long; teeth deltoid ¼ as long excepting the linear lower one which is nearly as long as the tube; bractlets linear, striate, as long as the tube: banner broader than long with a short claw; wings equalling the banner: free stamen much thickened at base and the scales prominent: pod 3–4 cm. long, compressed, 5–7 seeded, slightly curved, long-pointed; seed flattened, brown, marked with black spots.—Sierra de San Francisquito.

163. RHYNCHOSIA MINIMA DC.—Todos Santos, San José del Cabo.

164. CAJANUS INDICUS Spreng. ? Todos Santos.

165. CÆSALPINIA PANNOSA Brandegee. Described from small plants collected near Comondu. In the southern part of the peninsula it is sometimes ten or fifteen feet high, and is *C. Mexicana* var. *Californica* of the Xantus Collection.

166. Cæsalpinia pulcherrima Sw. "Tabachin." In cultivation at San José del Cabo.

167. Cæsalpinia (Pomaria) placida. Shrubby, 1–2 m. high, branching from the base; bark dark brown glabrous: pinnæ a single pair and an odd one; petiole 1 cm. or more long, glandular: leaflets 4–6 pairs, narrowly oblong, obtuse, crenulate, about 7 mm. long: racemes 6–12 cm. long: flowers 10–15 on pedicels 1½ cm. long or less, jointed above the middle; calyx lobes 6 mm. long, ovate-obtuse, imbricated in the bud, glandular, dark red: petals exceeding the calyx, bright yellow, bearing numerous yellow glands upon their lower half: stamens 10, hairy below: ovary densely glandular: ovules 4: pod 4 cm. long, 1 cm. wide, somewhat falcate, bearing numerous reddish stipitate glands.

The dark red stipitate glands abound on all parts of the inflorescence excepting the petals. It is a very handsome species, the bright yellow colored petals contrasting strikingly with the dark red of the sepals, pedicels and peduncles. It blossoms in February. Common about La Paz and also collected there by Dr. Palmer.

168. Hæmatoxylon boreale Watson.—La Paz, Todos Santos, San José del Cabo.

169. Parkinsonia. Torreyana Watson.—San José del Cabo.

170. Cassia bicapsularis L. Introduced.—Todos Santos.

171. Cassia emarginata L. "Palo de Zorillo." A small tree common along the base of the mountains.

172. Cassia villosa Mill.—San José del Cabo to San Bartolomé.

173. Cassia Tora L.—Miraflores.

174. Cassia occidentalis L.—San José del Cabo, San Bartolomé.

175. Cassia nicticans L. Very abundant about San José del Cabo.

176. Cassia Absus L.—Miraflores.

177. Bauhinia porrecta Sw. Var.? A large bush growing abundantly between Santiago and Buena Vista. Very near, if not identical with, this West Indian species.

178. Tamarindus Indica L.—Common in cultivation about San José del Cabo.

179. Prosopis juliflora DC.—La Paz.

180. Neptunia plena Benth.—San José del Cabo.

181. Desmanthus fruticosus Rose. A bush ten feet high.—San José del Cabo.

This must be *D. virgatus* of Bot. Sulph. as well as of the writer's previous list, from Magdalena Bay.

182. Desmanthus oligospermus. A prostrate spreading shrub; stems branching, 2 dm. long; leaves 1½ cm. long; pinnæ 2–4 pairs, a small gland between the lower pair; leaflets 8–12 pairs, sparingly pubescent especially upon the margins, oblique, linear-oblong, 1-nerved, 4 mm. long; stipules semisagittate, rigid; flowers in small heads on axillary peduncles, 1½ cm. long, nearly white; calyx 5-toothed, 1 mm. long; petals 5, 1½ mm. long, stamens 5, three times longer; bracts of the head stipitate, peltate, cordate-acuminate, caducous; pod 7 mm. long, 2 mm. wide, ovate-acuminate, 1–2 seeded, indehiscent; seeds oblique, flat, marked on the sides, smooth; cotyledons oval-oblong, sagittate at base, the space filled by the short radicle.

Common about San José del Cabo, growing in exposed situations. The legumes are nearly always one-seeded and the number in the head varies from five to ten.

183. Mimosa Xanti Gray. A bush 6–10 feet high. The leaves are three nerved at base; the legumes are an inch or more long, with an elongated linear tip, usually 3–4 seeded and setose upon the margins, sparingly so upon the sides. Very abundant.—San José del Cabo. Todos Santos, Sierra de la Laguna.

184, Mimosa distachya Cav. ? A spreading bush 2–3 mm. high, glabrous; thorns scattered, curved: pinnæ 4 pairs, the lowest a third the length of the upper one; leaflets on lower pair 1–2, on the upper 3–4, obovate, obtuse, apiculate, oblique, 2–3 nerved at base; petaloid stamens numerous; legume 3–4 cm. long, setose-hispid on the margins and both sides, the valves breaking into 3–5 joints. It differs from the description and figure of *M. distachya* in being entirely glabrous and in the outline of the leaf, and from *M. laxiflora* in its setose-hispid fruit.—San José del Cabo, Todos Santos, La Paz.

185. Mimosa laxiflora Benth.—Comondu and probably at La Paz in flower, the species from the latter place uncertain on account of the lack of fruit.

186. Leucæna retusa Benth. ? A slender shrub 10–15 feet high; stems in clusters of several with short ascending branches, the flowers borne at the top. In the specimens the petiolar gland is just below the lower pinnæ: these last are however often absent, but their places of attachment are always represented by scars as is the case in Dr. Watson's *L. lanceolata* where, they appear to have been small and soon deciduous.

187. Acacia filicina Willd.—San José del Cabo, Todos Santos.

188. Acacia amentacea Benth. Differing from Pringle's 2526 of 1889 in having puberulent leaves and pods.—San Gregorio, Comondu. At Todos Santos a

glabrous form but with narrower leaves than those of Pringle's specimens.

189. Acacia, sp. Without fruit; stipular spines few and minute, leaves small.—Todos Santos to La Paz.

190. Acacia, ? sp. La Paz.

Acacia Farnesiana Willd.—San José del Cabo.

191. Acacia Wrightii Benth. Collected at La Paz by Dr. Palmer. Contr. Nat. Herb., iii, 69.

192. Lysiloma candida Brandegee.—San José del Cabo, Todos Santos.

193. Lysiloma microphylla Benth. — Mountains near San José del Cabo and Todos Santos.

194. Calliandra Californica Benth. — Common about San José del Cabo.

195. Calliandra eriophylla Benth. Reported by Mr. Rose from La Paz.

196. Calliandra Coulteri Watson. — A loosely branched bush. The long stamens are always drooping giving a wilted appearance to the flowers. — Common about San José del Cabo.

197. Pithecolobium dulce Benth.—Todos Santos, La Paz, San José del Cabo.

198. Pithecolobium tortum Mart. ? A very handsome small tree with horizontal dark green leaves growing at low elevations at San José del Cabo and Todos Santos.

199. Pithecolobium flexicaule (Benth.) Contr. U. S. Herb., vol. ii, 101. This is Acacia sp. "Palo friorro" of the Proc. Cal. Acad., ii, 153. It is very abundant and may have been the *Acacia flexicaulis* of the Xantus Collection.

200. Albizzia Lebbek Benth. ? This is undoubt-

edly the plant of the Xantus Collection noted in Proc. Am. Acad., v, 158, as *Leucæna macrophylla?* with the remark "that from the pod and look of the foliage it may be an Albizzia." It was not in bloom at the time of my trips to the Cape Region, but very young pods were found with remnants of flowers about their base. By these old blossoms, it is made certain that the calyx is small, the corolla long tubular, the stamens numerous, exserted and monadelphous beyond the lobes of the corolla. Mr. Bentham writes, "In this genus, one to three of the central flowers of a head differ from the others in having elongated tubular corollas and the stamineal tube long exserted." These elongated flowers may be the fertile ones of the head and therefore the ones remaining about the base of the pod. The mature pod is exactly that of *A. Lebbek* in Icones Carpologica, and the descriptions of the species agree with my specimens. Albizzia is not an American genus, but this species has been introduced into the West Indies, from which place, if this tree is really *A. Lebbek*, it perhaps came. Several old large trees grow on the main street of San José del Cabo and their position and arrangement is such that they must have been planted. In the broad sandy mouths of cañons along the base of the mountains at San José del Cabo, Miraflores, Agua Caliente and Todos Santos, this small tree abounds and seems to be a native, but it may have spread from introduced or cultivated trees.

201. PRUNUS SALICIFOLIA HBK. Proc. Am. Acad., xxii, 411. A tree blossoming in January on the Sierra de la Laguna.

202. RUBUS, sp. Glabrous, stems trailing, leaves often 5-digitate. In bloom on the Sierra de la Laguna and Sierra de San Francisquito.

203. FRAGARIA MEXICANA Schl.—Sierra de la Laguna, in blossom.

204. Alchemilla hirsuta HBK. Flowers often reddish, ovule solitary.—Sierra de la Laguna.

205. Heteromeles arbutifolia Rœmer. A shrub six to ten feet high.—Sierra de la Laguna, flowering in January; Sierra de San Francisquito, fruit in October.

206. Ribes sanguineum Pursh. Flowers dull purple, fruit glabrous. Growing along streams near the summit of the Sierra de la Laguna and blooming in January.

207. Cotyledon nubigena. Glaucous; outer leaves broadly spatulate, abruptly acute, 6–8 cm. long, the inner narrower and acuminate: flowering stems several, 4–5 dm. high, divided near the top into 2–3, secund, ascending racemes: lower leaves or bracts cordate-lanceolate, 1 cm. long; floral bracts minute, much shorter than the 1–2 cm. long pedicels: calyx slightly pentagonal, divided nearly to the base into deltoid-lanceolate segments, 3–5 mm. long, equaling the corolla tube: corolla 1 cm. long, divided to the middle into linear erect petals, red above shading into yellow below: carpels 8 mm. long; styles erect.—Growing upon rocks of the summits of the Sierra de la Laguna.

208. Cotyledon farinosa B. & H. Reported by Dr. Gray from the Xantus Collection.

209. Rhizophora Mangle L. "Mangle dulce."—Salt water marshes about La Paz.

210. Laguncularia racemosa Gærtn.—La Paz and the Magdalena Bay lagoons.

211. Psidium pomiferum L. Escaped from cultivation near San José del Cabo, Miraflores, Todos Santos, etc.

212. Ammannia latifolia L.—San José del Cabo.

213. Cuphea, sp.—Sierra de San Francisquito.

214. Nesæa salicifolia HBK.—San José del Cabo, Sierra de la Laguna.

215. Epilobium Parishii Trelease.—Zoe, i, 210.

216. Jussiæa repens L. var. Californica Watson. Common in damp soil about Todos Santos, San José del Cabo.

217. Jussiæa octonervia Lam.—San José del Cabo.

218. Œnothera Drummondii Hook. var.—No. 35, Xantus, Proc. Am. Acad., viii, 581. This must be the plant of Xantus although the ovary and calyx lobes are nearly as densely pubescent as the leaves.—A littoral plant common between Rancho Tomate and Todos Santos, and also seen on the Gulf shore.

219. Œnothera rosea Ait.—Sierra de la Laguna.

220. Œnothera sinuata L.—Tops of the high mountains, generally distributed.

221. Lopezia clavata Brandegee.—Very abundant on the high mountains.

222. Gaura parviflora Dougl.—San José del Cabo.

223. Mentzelia adherens Benth.—Todos Santos, San José del Cabo.

224. Mentzelia aspera L. Leaves often not all lobed; corolla more than twice the length of the calyx, the segments united at base; filaments irregular in length and indefinite, 5–10 of the outer ones dilated; the upper part of the calyx promptly circumscissile from the ovary; seeds few, lobed, very rough and oblique.—San José del Cabo.

It is possible that there are two species confused under the name. The form here described, represented also by Palmer's No. 101 from Southwestern Chihuahua, is apparently nearest the West Indian original. Pringle's

No. 633, also from Chihuahua, has persistent calyx-lobes, longer stamens, and the more numerous seeds are thinner and less rough.

225. EUCNIDE CORDATA Kell.—La Paz, San José del Cabo.

226. TURNERA PUMILEA L.—Common about San José del Cabo.

227. TURNERA DIFFUSA Willd. var. APHRODISIACA Urban, "Damiana." Formerly exported in quantity for medicinal purposes. Common at low elevations.

228. PASSIFLORA FŒTIDA L.—San José del Cabo.

229. MOMORDICA CHARANTIA L.—Climbing over dwellings and garden fences and sparingly escaped.—San José del Cabo.

230. ECHINOCYSTIS BRANDEGEI Cogn. Proc. Cal. Acad., ser. 2, iii, 59.—Along the seashore. Todos Santos, San José del Cabo, La Paz.

231. ECHINOCYSTIS MINIMA (Kell.)—San José del Cabo.

232. BRANDEGEA MONOSPERMA Cogn. Cal. Acad., ser. 2, iii, 59. Barely entering the Cape Region near Todos Santos. The leaves are as variable as those of *Echinocystis minima*, running from nearly entire to very deeply lobed.

233. CYCLANTHERA (EUCYCLANTHERA) TESTUDINEA. Annual, glabrous; stems angular, sparingly branched, ½–1 m. high, climbing in bushes: petioles sulcate, 6–10 mm. long; leaves punctate-scabrous, triangularly 3-lobed; the middle lobe prolonged, the lateral ones sometimes quadrate or lobed, all acute or acuminate; base reniform with a sessile gland on the upper surface at each side; nerves prominent beneath: ♂-flowers in small clusters,

few-flowered: common peduncle 3–6 mm. long; pedicels capillary: calyx-teeth obsolete: corolla rotate, 2–3 mm. broad, equaling the ♀-flower. Calyx-teeth of ♀-flower very short: peduncle stout, equaling the petiole: fruit compressed, strongly gibbous, 12–15 mm. long, shortly rostrate, strongly aculeate with numerous stout flattened spines 2–4 mm. long; sides thin, membranaceous; ventral segment linear, thick and elastic; placenta thick, ⅔ as long as the capsule, three lobed at the free end and bearing 2–3 seeds, in as many cells, recurved with respect to the placenta, but erect in the capsule: seeds brown, scurfy and muricate, oblong, strongly compressed, 5 mm. long, with two marginal projections on each side—bearing a strong likeness to some species of turtle.

Sierra de San Francisquito, high mountain tops, Oct., 1891.

The dehiscence in this species is strongly elastic and quite regular, the placental column is attached near the center of the straight margin—and to the apex of the strong border which extends around the curved side. In dehiscence this thick broad band straightens itself and curves the contrary way separating from the thin sides, and drawing the seeds completely out of the cell.

234. SICYOS DEPPEI G. Don.—Very abundant in the region about Miraflores, often completely covering the hedges and small trees about the fields.

235. MELOTHRIA PENDULA L.?—Miraflores.

236. VASEYANTHUS ROSEI Cogn., Zoe, 1, 368, Pl. xi.—La Paz.

237. MAXIMOWICZIA SONORÆ Watson.—San José del Cabo.

This is apparently the same as the Guaymas plant, but the leaves are less dissected. The specimens from Magdalena Bay are of different habit, less glaucous and more punctate-scabrous. The stamens are four—one bilocular, the remainder unilocular. It may possibly be a distinct species.

238. BEGONIA (KNESEBECKIA) CALIFORNICA.—Herbaceous from a tuberous root, ½ m. high, glabrous, purple-tinged: lower leaves cordate, somewhat unsymmetrical, sparingly pilose at the top of the petiole and on the veins, equaling the petiole, 5–7 nerved and lobed, dentate-serrate and setiferous, 6 cm. wide, 4 cm. long; upper leaves very unsymmetrical, 2–3 nerved and lobed, dentate-serrate and setiferous; stipules 6–7 mm. long, 3 mm. wide, broadly lanceolate setiferous, persistent, those of the lower leaves unsymmetrical: cymes few flowered: bracts broadly acuminate setiferous: pedicels 3–4 cm. long, bibracteolate at the middle with very setiferous deciduous bracteolæ: flowers pink or purple: the male perianth 4-lobed, the two outer lobes broadly ovate, 7 mm. long, denticulate, the inner smaller; anthers obpyriform, emarginate: female perianth 5-lobed, the outer ones sparingly denticulate, 5 mm. long, the inner smaller; capsule 2 cm. long or more, 2–3 winged, the largest wing roundish-deltoid, 10–12 mm. in greatest width, the opposite wing 3 mm. wide, the dorsal small.—Sierra de San Francisquito.

239. MAMILLARIA sp.—A nearly globular species found only in flower from San José del Cabo to the summit of the mountains.

240. MAMILLARIA GOODRIDGII Scheer.—San José del Cabo.

241. MAMILLARIA ROSEANA Brandegee, Zoe, ii, 19.—Common at low elevations.

242. CEREUS PRINGLEI Watson.—Common in the low country.

243. Cereus striatus Brandegee, Zoe, ii, 19.

244. Cereus pecten-aboriginum Engelm.—Todos Santos, La Paz, San José del Cabo.

245. Cereus (Echinocereus) sp.—Todos Santos, La Paz.

246. Cereus sp.—A species with numerous stems, six or eight feet long, hanging from the rocks of the Sierra de la Laguna, bearing at the time of collection neither flowers nor fruit.

247. Cereus gummosus Engelm.—Abundant in the Cape Region.*

248. Cereus Schottii Engelm.—Common.

249. Cereus Thurberi Engelm.—Common.

250. Cereus Eruca Brandegee, Zoe, ii, 20. Perhaps extra limital.

251. Opuntia (Platopuntia) sp.—Common.

252. Opuntia rotundifolia Brandegee, Zoe, ii, 21. Todos Santos, La Paz.

253. Sesuvium Portulacastrum L.—Growing about the borders of salt water marshes.

254. Trianthema monogyna L.—Very abundant at San José del Cabo.

255. Mollugo verticillata L.—Juncal and very common about San José del Cabo.

256. Mollugo Cerviana Seringe.—San José del Cabo, Agua Caliente; growing in sand or cultivated fields.

257. Hydrocotyle umbellata L.—Growing in streams and irrigating ditches at Todos Santos and San José del Cabo.

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*Zoe ii, 20.

258. Arracacia Brandegei Coulter and Rose.—At high elevations in the mountains.

259. Garrya Wrightii Torr.—Sierra de la Laguna.

260. Houstonia brevipes Rose. Common in the mountains.

261. Houstonia asperuloides (Benth.) — Todos Santos, La Paz, San José del Cabo.

262. Houstonia Brandegeana Rose.—La Paz.

263. Houstonia arenaria Rose. Collected by Dr. Palmer at La Paz and by the writer at San José del Cabo. Annual, flowers white, ovary containing eight ovules. Young specimens.

264. Randia armata DC.?—San José del Cabo.

265. Chiococca racemosa Jacq.—Foothills of the Sierra de San Francisquito.

266. Diodia teres Walt., var. angustata Gray.—San José del Cabo.

267. Spermacoce tenuior L.—San José del Cabo.

268. Mitracarpus linearis Benth.—San José del Cabo, Innocente.

269. Mitracarpus villosus Ch. & Sch.—San José del Cabo.

270. Mitracarpus schizangius DC.—Growing in clumps from a woody base. Specimens variable in degree of pubescence, length of style, etc.—Hills about San José del Cabo and in the Sierra de San Francisquito.

271. Richardia scabra L.—San José del Cabo.

272. Galium microphyllum Gray.—Sierra de San Francisquito and Sierra de la Laguna. The plants are

sparingly long-pubescent. *Relbunium polyplocum* Hemsl. Gray, Synoptical Flora, 41.

273. GALIUM UNCINULATUM DC. ? — Sierra de la Laguna.

274. VALERIANA sp. — Common in the high mountains.

275. HOFMEISTERIA FASCICULATA Walp. — La Paz, San José del Cabo.

275½. STEVIA sp. White flowered. — Sierra de la Laguna and de San Francisquito.

276. CARMINATIA TENUIFLORA DC. Common at high elevations in the mountains.

277. EUPATORIUM QUADRANGULARE DC.?—Sierra de San Francisquito.

278. EUPATORIUM GRANDIDENTATUM DC. var. LAXIFLORUM Gray.—Sierra de la Laguna.

279. EUPATORIUM sp.—Sierra de la Laguna.

280. EUPATORIUM sp.—San Bartolomé, Sierra de San Francisquito.

281. BRICKELLIA COULTERI Gray.—San José del Cabo.

282. BRICKELLIA CAVANILLESII Gray.—Sierra de la Laguna.

283. BRICKELLIA sp.—Miraflores.

284. BRICKELLIA sp.—San Bartolomé.

285. BRICKELLIA sp.—La Paz.

286. APLOPAPPUS ARENARIUS Benth. Low, densely glandular pubescent, with thick leaves and large heads of yellow flowers; growing on the seashore and covered by adhering particles of sand.—San José del Cabo.

287. APLOPAPPUS SPINULOSUS DC. Growing on hills,

in rounded clumps, branching freely, 3–4 feet high.—Todos Santos.

To this species, rather than to the preceding, I think Palmer's No. 17, from La Paz, should be referred.

288. Coulterella capitata Rose.—Sand beach near La Paz.

289. Bigelovia diffusa (Benth.) San José del Cabo, La Paz.

290. Aster spinosus Benth. San José del Cabo.

291. Aster exilis Ell. San José del Cabo.

292. Aster sp. San José del Cabo.

293. Conyza Coulteri Gray.—Mountains of the interior.

294. Erigeron Canadensis L. San José del Cabo, Sierra de la Laguna.

295. Baccharis cærulescens DC.—Proc. Am. Acad., v, 160.

296. Baccharis viminea DC.—San José del Cabo.

297. Baccharis sp. Male flowers only, of an unidentified species from the high mountains.

298. Pluchea subdecurrens DC.—San José del Cabo.

299. Anaphalis margaritacea Benth. & Hook.—Sierra de la Laguna.

300. Gnaphalium leptophyllum DC.—Sierra de la Laguna.

301. Melampodium divaricatum DC.—San José del Cabo, in fields.

302. Melampodium sinuatum. Perennial, 2–4 dm. high, with many branching stems from a somewhat woody base, grayish rough-pubescent all over: leaves 3–4 cm. long, elliptic-oblong, obtuse, narrowed but connate at base,

sinuate or somewhat lobed on the margin: peduncles several times exceeding the leaves, in fruit often 1 dm. long: heads small; lobes of the involucres about five, rounded and ciliate, united to the middle, penninerved: rays bright yellow, 6–10 mm. long, much exceeding the involucre: fruiting bracts without hoods, clavate-oblong, rough and pubescent, with the lateral edges spinose-tubercular at the point of attachment, the inner basal angle sharply projecting, the akene exposed somewhat by the falling ray: disk strongly convex, the flowers shorter than the plicate-truncate, crenate-dentate yellow-tipped bracts, only the few central ones antheriferous, the very numerous others reduced to linear-clavate rudiments, nearly as long as the bracts and ciliate at the summit.—San José del Cabo.

303. Parthenice mollis Gray.—La Paz to Todos Santos.

304. Hymenoclea monogyra T. & G.—San José del Cabo to La Paz.

305. Franseria flexuosa Gray.—San Pedro. Small tree fifteen feet high.

306. Franseria Magdalenæ Brandegee.—San José del Cabo.

307. Franseria ambrosioides DC.—San José del Cabo.

308. Xanthium strumarium L.—San José del Cabo.

309. Heliopsis parviflora Gray. Akenes either smooth or papillose.—High mountains.

309½. Eclipta alba Hasskarl.—San José del Cabo.

310. Sclerocarpus divaricatus (Benth.)? This must be the plant mentioned, under *S. uniserialis*, by Dr. Gray in the list of Xantus' plants. It agrees better

with the plant of Bentham, but may not be the same. The broad foliaceous bracts of the involucre are 5 in a single series, many times surpassing the bracts of the receptacle. The fructiferous bracts are setose at the summit, and more or less on the dorsal tuberculations. The outer rows in age have a sharply tuberculate dorsal angle and scattered tuberculations over the upper third. The apex of the curved pyriform akene projects slightly at the summit, and is very slightly (in the outer rows) surpassed by the peak of the bract; pappus crown nearly obsolete.

311. Alvordia glomerata Brandegee. Specimens from Todos Santos and San José del Cabo are much taller and decidedly frutescent. The flowers are smaller, solitary or rarely 2–3 in the involucres, always rayless. The pappus scales are divided into numerous acuminate narrow paleæ of irregular length.

312. Viguiera deltoidea Gray. The leaves are often somewhat irregularly dentate or crenate.—Todos Santos, La Paz, San José del Cabo.

313. Viguiera tomentosa Gray.—Todos Santos, La Paz, San José del Cabo and the summits of the highest mountains.

314. Encelia Palmeri Vasey & Rose.—La Paz.

315. Encelia farinosa Gray.—La Paz.

316. Verbesina erosa. Herbaceous and many stemmed from a woody root, scabrous and hirsute, 1–1½ m. high: leaves ovate-lanceolate, opposite, 1 dm. long on short; margined petioles, not decurrent, scabrous above, hirsute below, serrate: heads loosely corymbose, 15 mm. high, either with rays or rayless: bracts of the involucre ovate-acuminate, in 2–3 series, hirsute: rays when present oblong, 10 mm. long, fertile: akenes obovate, usually

smooth, margined with a wing of variable width that is generally broader than the akene, irregularly lacerate and ciliate: awns two, as long as the akene and spreading.

This plant is common on the high mountains of the cape region and sometimes grows in deep cañons at lower elevations. The leaves are often coarsely and doubly serrate and white hirsute below. The wing of the akene is sometimes entire, and often narrow. Some of the marginal ones may be wingless, and are then tuberculate.

317. HETEROSPERMUM XANTI Gray.—La Paz, San José del Cabo and in the mountains.

318. BIDENS NUDATA Brandegee, Zoe, i, 309. Mountains of the interior.

319. BIDENS REFRACTA Brandegee, Zoe, i, 310. Miraflores.

320. BIDENS TENUISECTA Gray.—Foothills of the mountains near Agua Caliente.

321. BIDENS LEMMONI Gray.—High mountains.

322. BIDENS PILOSA L.—Mountains of the Cape Regions.

323. BIDENS HETEROPHYLLA Ort.—High mountains.

324. GALINSOGA PARVIFLORA Cav. Plants small and destitute of pappus.—Sierra de la Laguna and Sierra de San Francisquito.

325. PERITYLE CRASSIFOLIA. Annual, stems ribbed, branching ½ m. high, densely arachnoid-tomentose, the glands masked by the pubescence, but causing the thick leaves to glisten in the sun much like *Mesembryantheum æquilaterale*: leaves thick, reniform or cordate-ovate, crenate, on petioles of the same length: heads large, many flowered, rays white, conspicuous; akenes curved, pubescent on the sides, at least the outer ones ciliate on

the margins, with one slender, retrorsely barbed awn and a short crown of lacerate scales.

Very few akenes seem to mature, especially among those of the disk. The plant has a very different appearance from the other white-flowered species of the genus. It grows along the seashore at San José del Cabo.

326. PERITYLE CUNEATA Brandegee. Zoe i, 54. Sierra de la Laguna and a single specimen in the wash of the San José River.

327. PERITYLE MINUTISSIMA Rose *ined.*—San José del Cabo.

328. PERITYLE EMORYI Torr.—La Paz, San José del Cabo.

329. PERITYLE MICROGLOSSA Benth.—La Paz, San José del Cabo.

330. PALAFOXIA ARENARIA Brandegee.—Sand beach at La Paz.

331. POROPHYLLUM GRACILE Benth.—Todos Santos, San José del Cabo.*

332. POROPHYLLUM FILIFOLIUM DC.†—San José del Cabo.

333. DYSODIA SPECIOSA Gray.—Todos Santos, La Paz, San José del Cabo.

334. TAGETES LACERA Brandegee. Zoe i, 314.—Sierra de la Laguna.

335. TAGETES MICRANTHA Cav.—Sierra de la Laguna, Sierra de San Francisquito.

336. TAGETES SUBULATA Llave & Lex.—Sierra de San Francisquito.

337. LEPTOSYNE PARTHENIOIDES (Benth.) San José del Cabo.

*Zoe i, 312.

338. LEPTOSYNE DISSECTA (Benth.) Bot. Sulph. 29. Said to have been collected at Cape St. Lucas.

339. LEPTOSYNE HETEROCARPA Gray. Zoe i. 308.—San José del Cabo, Sierra de la Laguna.

340. PECTIS PALMERI Watson.—La Paz.

341. PECTIS PUNCTATA Jacq.—Near Santiago.

342. PECTIS MULTISETA Benth.—San José del Cabo, La Paz.

343. PECTIS PROSTRATA Cav.—Agua Caliente.

344. BEBBIA ATRIPLICIPOLIA (Benth.)—Common.

345. HELENIUM THURBERI Gray. Growing along the banks of the stream at Rancho Colorado and perhaps not really within the Cape Region.

346. PEREZIA MICROCEPHALA Gray.—Sierra de la Laguna.

347. TRIXIS ANGUSTIFOLIA DC.—San José del Cabo.

348. HIERACIUM FENDLERI, Gray.—Sierra de la Laguna.

349. HIERACIUM, sp.—Sierra de San Francisquito.

350. MALACOTHRIX XANTI Gray.—San José del Cabo.

351. SCÆVOLA PLUMIERI Vahl.—Abundant upon the Todos Santos beach and also found at San José del Cabo.

352. LOBELIA LAXIFLORA HBK. var. ANGUSTIFOLIA DC.—Common along the streams of the Sierra de la Laguna.

353. HETEROTOMA AURITA. Annual, branching, slightly hirsute, 1–3 dm. high: lower leaves variable in form, round-cordate or ovate, crenate to laciniate-serrate, obtuse or acute, 3–4 cm. long on petioles of nearly the same length; upper leaves narrower, laciniate-serrate: flowers 10–15 mm. long, blue, on leafless racemes 10–15 cm. in length: posterior lobes of the corolla deeply

divided, ovate; anterior lobes narrowly linear: calyx spurred; posterior lobes erect, linear lanceolate; anterior lobes similar to and distinct from the others, standing out at right angles to the upper ones.

Compared with *H. arabidoides*, the spur is much longer, the posterior lobes of the corolla much more deeply divided and of a different shape. The two anterior calyx lobes are situated near the end of the spur, distant from the upper ones. A handsome species common in the high mountains.

354. Arbutus Menziesii Pursh. Leaves large, tomentose below. A medium sized tree, blooming in January.—Common on the summits of the high mountains.

355. Samolus Valerandi L. var. repens. Stems creeping and rooting at the joints, forming entangled mats often many feet in extent.—Sierra de la Laguna on moist rocks.—Sierra de San Francisquito on stream banks.

This plant differs strikingly in habit from typical *S. Valerandi*, but some forms collected by J. G. Lemmon (No. 2645) in the Huachuca mountains in Arizona are intermediate between them.

356. Macreightia intricata Gray, Proc. Am. Acad. v, 163. The leaves are described as "leviter triplinervis," but the lateral nerves are short, given off above the base and usually hardly visible: the reflexed pedicels of the hermaphrodite flowers are from about one-half to the full length of the leaves, thickened above and with a small bract at the lower third; they are apparently always solitary, though from the approximation of the axils they frequently appear clustered: calyx lobes ovate, apiculate-replicate, the lobes at flowering longer than the basal part: corolla 5–7 mm. cylindrical-urceo-

late, conical in the bud, the inner surface glabrous, dark-brown, the outer, excepting the base, densely gray-villous; the tube twice longer than the spreading dextrorsely convolute lobes: stamens 3–5, distinct; filaments filiform, attached to the base of the corolla, twice as long as the anthers which are glabrous and long-apiculate by the produced connective; the hairy rudiment of a stamen occupies the middle of one lobe between the two corresponding sinuses: ovary densely villous, 6-celled, 6-seeded; style 3-lobed half way to the base, the lobes similar to but much smaller than those of the corolla: fruit slightly pubescent, globose, 15 mm. in diameter; seeds twice as long as broad, rounded and thick on the back, straight and thin on the inner margin, the sides concave; embryo half as long as the smooth corneous albumen; the subulate radicle half as long as the cotyledons which are sometimes three.

From the description of *Maba Caribæa* (DC.) Prodr., viii, 222, this plant appears to be too closely related to it..

357. VALLESIA DICHOTOMA Ruiz & Pavon. San José del Cabo, La Paz, Todos Santos.

358. PLUMERIA ACUTIFOLIA Poir.? "Cacaloxochitl" Very nearly agreeing with the descriptions and drawing of this species. The leaves are glandular tipped: the lobes of the corolla are twice longer than the tube; the mature follicles, 15–20 cm. long, are divergent and recurved. This striking tree is twenty feet high, sparingly branched near the top with the branches terminated by large leaves and showy white flowers. Not uncommon from San José del Cabo to Triumfo and San Pedro.

359. PHILIBERTIA PAVONI Hemsley.—San José del Cabo.

360. PHILIBERTIA LINEARIS, var. HETEROPHYLLA Gray.—San José del Cabo.

361. PHILIBERTIA PALMERI Gray. Agrees with Palmer's flowering specimens, excepting that the top of the stigma is slightly more umbonate. The specimens vary from very pubescent to glabrous. The follicles when young are pubescent, and finally become 4–5 cm. long, 1–1½ cm. thick, and taper from near the end to a point. The "interior 5 scales" in the living plant are white, globular and prominent. Common climbing over the hedges at San José del Cabo and Todos Santos.

362. ASCLEPIAS SUBULATA Decaisne.—San José del Cabo, La Paz.

363. METASTELMA CALIFORNICUM Benth.—San José del Cabo.

364. PATTALIAS, sp.—San Jose del Cabo, Todos Santos.

365. GONOLOBUS, sp.? In fruit only.—Near La Paz.

366. HIMANTOSTEMMA PRINGLEI Gray. Common near the seashore and in sandy gulches about San José del Cabo. A specimen from Buena Vista has very much larger and thinner leaves, and few trichomes in the throat. Dr. Gray says these trichomes are "apparently flat," but in our specimens they are clavate.

367. ROTHROCKIA CORDIFOLIA Gray. The tube of the corolla, which is plicate at the sinuses, is ⅓ as long as the limb. The stigma is bilobed at the summit and irregularly muricate, usually in two divisions, a short distance below. The anthers are broad and inappendiculate, and the lobes of the thick corona are two-pointed. The rather slender follicles are either smooth or tuberculate, narrowed a short distance above the base, and when young are eaten raw by the inhabitants.—San José del Cabo, Miraflores. Known as "Talayote."

Dr. Gray compares Rothrockia to Enslenia or Roul linia, but it would probably be better placed among the Gonolobeæ.

368. Polypremum procumbens L.—San José del Cabo.

369. Buddleia crotonoides Gray. Proc. Am. Acad., v, 165. Collected by Xantus at Cape San Lucas.

370. Eustoma exaltatum Griseb.—San José del Cabo.

371. Gilia floribunda Gray.—Sierra de la Laguna.

372. Lœselia ciliata L. Cells either one or two seeded, tube of the corolla slightly exserted, ciliæ very short and inconspicuous.—Sierra de la Laguna. Common about the base of the mountains.

373. Cordia Palmeri Watson?—San José del Cabo.

374. Bourreria Sonoræ Watson.—San José del Cabo, La Paz.

375. Tournefortia velutina HBK. Proc. Am. Acad., v, 164. Collected by Xantus.

376. Heliotropium Curassavicum L.—San José del Cabo.

377. Heliotropium parvifolium L.—San José del Cabo.

378. Heliotropium innundatum.—San José del Cabo.

379. Heliotropium fruticosum L.—San José del Cabo.

380. Heliotropium phyllostachyum Torr.—San José del Cabo.

381. Heliotropium, sp. San José del Cabo.

382. Krynitzkia heliotropioides Gray. Collected by Xantus at Cabo San Lucas. Proc. Am. Acad. v, 164.

383. KRYNITZKIA MICROMERES Gray? La Paz. Contrib. U. S. Herb. iii. 73.

384. KRYNITZKIA LEIOCARPA F. & M.—La Paz, l. c.

385. KRYNITZKIA ANGUSTIFOLIA Gray in Coll. Xantus, under *Eritrichium*.

386. IPOMÆA PES-CAPRÆ Sweet. Calyx lobes slightly mucronate; stems sixty feet in length, prostrate along the sand. Ocean beach at Todos Santos, San José del Cabo, La Paz.

387. IPOMÆA ACETOSÆFOLIA Rœm. & Sch.—Seashore at Todos Santos, San José del Cabo.

388. IPOMÆA MEXICANA Gray.—San José del Cabo.

389. IPOMÆA TRIFIDA Don. var. TORREYANA Gray. Todos Santos.

390. IPOMÆA BRACTEATA Cav.—Common about the base of the mountains.

391. IPOMÆA COCCINEA L.—Sierra de la Laguna, San José del Cabo.

392. IPOMÆA AUREA Kell.—Common at low elevations.

393. IPOMÆA QUAMOCLIT L.—San José del Cabo.

394. IPOMÆA MURICATA Cav.—Sierra de San Francisquito.

395. IPOMÆA JALAPA Pursh.—San José del Cabo.

396. IPOMÆA COSTELLATA Torr.—Miraflores.

397. IPOMÆA BONA-NOX L.—Sierra de San Francisquito.

398. IPOMÆA, sp.—Miraflores.

399. IPOMÆA, sp. Low and prostrate-twining. Flowers small, bright yellow.—Sierra de San Francisquito.

400. JACQUEMONTIA ABUTILOIDES Benth.—San José del Cabo, La Paz, Todos Santos.

401. Jacquemontia violacea Griseb.—San José del Cabo.

402. Dichondra argentea Willd.—Sierra de la Laguna.

403. Evolvulus alsinoides L.—San José del Cabo, San Francisquito.

404. Cuscuta indecora Choisy?—San José del Cabo, on Boerhaavia.

405. Cuscuta leptantha Engelm.—La Paz, on Euphorbia.

406. Cuscuta Palmeri Watson.—La Paz. Contr. U. S. Herb., i. 73.

407. Cuscuta Americana L.—La Paz. Collected there also by Palmer.

408. Cuscuta obtusiflora HBK.—Soledad, and probably within our limits.

409. Cuscuta tinctoria Mart.?—San Bartolomé.

410. Solanum Hindsianum Benth.—San José del Cabo.

411. Solanum tuberosum L. var. boreale.—High mountains. Not common.

412. Solanum. sp. A small annual.—San José del Cabo.

413. Chamæsaracha Coronopus Gray.—Soledad, and perhaps to be found in the Cape Region.

414. Capsicum baccatum L.—Miraflores, San Bartolomé.

415. Lycium umbellatum Rose. Contrib. U. S. Herb., vol. i, 74.

416. Lycium brevipes Benth. Xantus coll. Proc. Am. Acad., v. 166.

417. Lycium Andersonii Gray, var.—San José del Cabo.

418. Lycium Richii Gray.—La Paz.

419. Physalis æquata Jacq.?—San José del Cabo.

420. Physalis crassifolia Benth. Contrib. U. S. Herb. l.c.

421. Physalis angulata L.?—San José del Cabo.

422. Physalis glabra Benth.—Todos Santos, San José del Cabo.

423. Datura discolor Bernh.—San José del Cabo.

424. Nicotiana trigonophylla Dunal.—San José del Cabo.

425. Nicotiana rustica L.—Soledad. Probably introduced, but now well established and abundant in the surrounding region. Not before found on the peninsula and not seen in the Cape Region proper.

426. Nicotiana Mexicana Schlecht. Proc. Am. Acad., v, 166.

427. Antirrhinum cyathiferum Benth.—San José del Cabo.

428. Russellia verticillata HBK.? The characters relied upon to separate the species of Russellia appear to be somewhat uncertain. Specimens collected on the Sierra de la Laguna are rather densely pubescent and have very stiff upright branches, with small leaves which are rugose, cordate-ovate and nearly sessile. The many-flowered peduncles are very short. Plants collected at San José del Cabo apparently the same species are less stiff, nearly glabrous, the peduncles somewhat longer, and the ovate to lanceolate leaves taper to slender petioles. The leaves in both forms are more or less covered above and below by thin orbicular scales—exactly

those described by Zuccarini as belonging to *R. juncea*. The ribs of the stems are produced by the decurrent petioles—a pair to each. The different portions of the same stem are often 4, 6 or 8-ribbed, according as the leaves are 3–4-verticillate or simply opposite, and it is sufficiently obvious that species founded in whole or great part upon this character are of rather difficult maintenance.

429. Mimulus luteus L.—High mountains.

430. Stemodia durantifolia Swartz. — San José del Cabo.

431. Herpestis Monniera HBK.—In damp soil, Todos Santos, San José del Cabo.

432. Herpestis chamædryoides HBK. — In the mountains near Triumfo.

433. Scoparia dulcis L.—Todos Santos.

434. Buchnera Mexicana Hemsley. var. flowers nearly white.—High mountains.

435. Castilleia Bryanti Brandegee.—Sierra de la Laguna.

436. Conobæa intermedia Gray. — Todos Santos and La Paz.

437. Clevelandia Beldingi Greene. A single belated specimen from Sierra de la Laguna, but abundant at the proper season, September–November, on the Sierra de San Francisquito. Specimens taller with more dissected leaves than those from which the description was drawn. The original diagnosis was so brief and imperfect that a fuller one is here appended.

Annual, slender, branching, 1–3 dm. high, scabrous-pilose with spreading hairs, and very sparingly glandular above; leaves linear with few filiform divisions; bracts 3-parted, usually shorter than the calyx, the tips whitish;

calyx about equally cleft before and behind, the lobes about as long as the tube and cleft laterally but not so deeply: corolla 12–15 mm. long, twice the length of the calyx, white becoming purplish, curved funnel-form with a pubescent line along the back terminating in a blunt point between the united upper lobes; lower lobes all alike, spreading, not saccate, somewhat longer, much wider and more deeply divided than the upper, all crenate: stamens included; the upper cell of each anther twice the length of the lower: style thickened upward, little shorter than the corolla: stigma disk-shaped, sub-2-lobed; capsule oblong, apiculate.

This plant differs from Orthocarpus, as Dr. Gray remarked, by its differently shaped corolla and included stamens. Nuttall's Euchroma (*Orthocarpus pallescens* and *O. pilosus*) is, however, almost intermediate between Clevelandia and true Orthocarpus in the former respect.

438. TECOMA STANS Juss. A bush or small tree common along the base of the mountains.

439. MARTYNIA ALTHEÆFOLIA Benth.—San José del Cabo.

440. ELYTRARIA TRIDENTATA Vahl.—San José del Cabo.

The flowers of Elytraria appear to have been little noticed. In all our specimens the upper lip is bilobed, the lower deeply 3-cleft, and each division bilobed. The petaloid stigma is wider than either of the lobes of the upper lip, and in vernation is folded over the stamens. In the expanded flower it looks exactly like the third lobe of the upper lip, and was undoubtedly mistaken for one by Œrsted in "Mexicos og Centralamericas Acanthaceer," for in describing *E. microstachya* he says, "limbi quadripartiti subbilabiati labio superiore 3-fido, lacinia media lateralibus duplo latiore." The seeds are angled by mutual pressure, and soft-muricate; radicle straight. The abuminous layer is not separable from the testa.

441. Calophanes peninsularis Rose. San Jose del Cabo.

442. Ruellia, sp. Flowers large, white, very fragrant. San José del Cabo.

443. Berginia Palmeri Rose ?—Todos Santos.

444. Beloperone Californica Benth.—Todos Santos, San José del Cabo, La Paz.

445. Beloperone hians Brandegee.—Todos Santos.

446. Justicia Palmeri Rose. Contributions U. S. Herb., vol. i, 75. La Paz, San José del Cabo.

447. Justica insolita Brandegee.—Todos Santos, La Paz.

448. Henrya costata Gray. More hirsute and glandular than Mexican specimens, leaves large with less prominent nerves, flowers white.—Sierra de la Laguna.

449. Tetramerium hispidum Nees.—Sierra de la Laguna.

450. Tetramerium ovalifolium Œsreted ? This is the *Dianthera Sonoræ ?* of the Comondu collection. The specimens were past flowering.—Sierra de la Laguna.

451. Carlowrightia Arizonica Gray. In spite of the white or ochroleucous flowers it is probably to this species instead of *C. cordifolia* that the plants collected at Comondu and San Julio should be referred. Forms which I am unable to separate from them have been since collected on the Sierra de la Laguna. They all have the entire posterior lip thickened and yellowish at the center and contracted below; the filaments more or less pubescent. The San Julio specimens are small leaved and

quite as "enervis" as Pringle's Arizona examples. The specimens from Comondu have some of the lower leaves an inch in length, somewhat cordate at base and in these larger leaves the veins are much more evident. The plants from Sierra de la Laguna have a more spreading pubescence and the lower cordate-ovate leaves are two inches in length on petioles half as long. *Carlowrightia cordifolia* Gray, at least our example of Palmer's No. 224, of 1885, differs very much from the other species; the tube of the corolla is short, but the three anterior lobes are united for some distance above the separation of the dilated posterior lip; the deltoid filaments are much shorter than the corolla and the ovate capsule is almost sessile, the single mature seed is ovate-acuminate. The whole plant is very minutely pubescent and the flowers, as Mr. Rose notes, are arranged unilaterally along the spike. These variances from Dr. Gray's description are so many and so great as to lead to the suspicion of the mixture of plants under the number.

452. CARLOWRIGHTIA ? PECTINATA. Perennial in thick clumps, 2–3 dm. high; branches slender, ramose, geniculate and rooting at the swollen joints wherever in contact with the damp earth, the bark of the older ones white and shreddy, the younger ones apt to be pubescent in lines: leaves glabrous, linear-acuminate, 3–4 mm. broad, 25–45 mm. long, becoming revolute: inflorescence, somewhat paniculate-spicate; flowers dark-purple, scattered on the slender branchlets: calyx deeply 5-cleft; lobes linear, nearly equal, as long as the corolla tube, a little shorter that the bracts and longer than the bractlets which are very like them in form: corolla 6–8 mm. long, three times the length of the calyx, almost rotate, the deeply 4-parted limb four times the length of the tube: filaments pubescent, nearly equaling the corolla; anthers

muticous, parallel, and nearly of the same length: style filiform; stigma minutely bilobed; ovary pubescent; ovules a pair to each cell: capsule clavate, 7 mm. long, pointed above, long stipitate below; seeds 4, or by abortion fewer; retinacula stout, nearly horizontal, all approximated—when only too seeds are developed, one in each cell, they are minutely muricate on the back and very deeply on the inner face; if the second seed is developed it is very different from the inner and so arranged as to embrace it by an overlapping edge; both sides are nearly smooth, but the margin is strongly pectinate on one side, the other side rolled in over the second seed; the radicular angle is prolonged and pectinate.—San José del Cabo on shaded hillsides.

453. CARLOWRIGHTIA? FIMBRIATA. Annual, erect, 1 metre or less in height, paniculate-branching above, very minutely puberulent; stems whitish, with shreddy bark and swollen nodes almost winged by the shortly decurrent petioles: leaves nearly glabrous. 3–6 mm. wide, 50–90 mm. long, linear-lanceolate, long acuminate, tapering to a sessile base—the petiole decurrent and persistent: inflorescence naked-paniculate at the ends of the branches; bracts and bractlets similar in shape but shorter than the subulate lobes of the deeply 5-cleft calyx: corolla 7–8 mm. long, bright straw yellow: the oval nearly equal lobes four times as long as the tube, which is a little exceeded by the calyx-lobes; posterior lobe of the corolla a little narrower than the others and with two small divaricate lobes; filaments very minutely pubescent, shorter than the corolla; anthers rather large the cells parallel and nearly equal: capsule 8–9 mm. long, pubescent only at the apex, ovate, the stipe longer than the body; seeds two in each cell nearly as in the preceding species, but the two inner ones minutely prickly on the margin: the

thin margin of the outer ones as well as their radicular prolongation, erose-fimbriate.—Between San Pedro and La Paz.

454. Dicliptera resupinata Juss. ? This must be the plant so listed by Dr. Gray in the collection of Xantus. The pedicels are however much shorter than in Cavanilles' plate, and densely spreading-hirsute. The whole plant is pubescent and the murications of the seed are sparse and not subulate.

455. Dicliptera formosa. Perennial, woody at base: stems numerous, often a metre in height, rather densely spreading-pubescent, sparingly branched; leaves lanceolate-acuminate, pubescent above and below, 4–6 cm. long, the lower on slender petioles ⅓ their length, inflorescence in loose and distant verticillasters; peduncles very short, often nearly obsolete, with two linear-acuminate bracts at summit; pedicels 3–5, densely spreading-hirsute, usually much shorter than the foliar bracts which are cordate-ovate, pubescent, 18–25 mm. long, barely mucronate; internal bracts rather broad acuminate-pubescent like the calyx and about equaling it: calyx 4 mm. long, the acuminate lobes twice as long as the tube: corolla rose-purple, 30–35 mm. long, 2-lobed nearly to the middle: proper tube narrow, about as long as the little broader throat: upper lobe ovate, entire, lower oblong, narrower, minutely 3-lobed, filaments very broad, nearly as long as the corolla: stamens oblique, disjoined: style as long as the stamens, the lobes obtuse and equal: capsule oval, glabrous, 4-seeded, seeds flattened, pubescent-muricate.—Summit of the Sierra de San Francisquito.

456. Dianthera, sp. Somewhat intermediate between this genus and Siphonoglossa.—San Bartolomé.

457. Lantana involucrata L.—Sierra de la Laguna.

458. Lippia Palmeri Watson.—Miraflores.

459. Lippia nodiflora Mx.—San José del Cabo.

460. Lippia formosa. Shrubby, 2–4 mm. high, scabrous, pubescent: leaves opposite, obovate-cuneate, coarsely crenate, dentate, prominently pinnately-veined, rugose, 2–2½ cm. long, scabrous above, but the pubescence longer and softer below: peduncles axillary, twice as long as the leaves: heads 2–2½ cm. broad: bracts membranaceous, minutely pubescent, reticulate-veined, light rose-colored, cordate, 10–15 mm. long and broad, the outer acute, the inner ones obtuse: calyx 2-cleft, densely white, long pubescent: corolla light rose-colored, 6 mm. long, tube twice the length of the calyx, ampliate above; fruit 2–3 mm. long, nutlets easily separable.

A common bush with rather showy flowers, growing on the hills about Todos Santos. It is related to the Brazilian species of Schauer's section Rhodolippia.

461. Lippia montana. Shrubby, 1–2 mm. high, sparingly pubescent: leaves opposite, rugose, oblong-ovate, 20–30 mm. long, pustulate-scabrous above, minutely scabrous below, serrate-dentate, the dentations terminated by bristles: petioles ⅓ the length of the leaves: inflorescence of axillary short-peduncled heads at the ends of the branches: heads about 2 cm. in diameter: bracts herbaceous, 3-nerved, oblong-acuminate: calyx 2-parted, long-pubescent, 2 mm. long: corolla yellow, reddening in age; tube ampliate above, three times the length of the calyx: nutlets easily separable.—Foothills of Sierra de la Laguna, San José del Cabo, San Bartolomé.

462. Citharexylum, sp. near *C. villosum*.—Miraflores.

463. Priva echinata Juss.—San José del Cabo.

464. Avicennia nitida Jacq.—Sometimes a small tree fifteen feet high.—La Paz.

465. Hyptis tephrodes Gray.—Todos Santos, La Paz, San José del Cabo.

466. Hyptis laniflora Benth. Todos Santos, La Paz, San José del Cabo.

467. Hyptis Emoryi Torr.—San José del Cabo.

468. Hyptis collina. Herbaceous from a perennial root; stems clustered, slender, quandrangular, striate, minutely pubescent: internodes twice the length of the leaves or more: leaves ovate, rather deeply and often doubly crenate-serrate, very minutely brownish-pubescent above and below, 1½–2½ cm. long, on slender petioles from ½ to ⅔ their length: inflorescence axillary, racemose; heads small, 6–10-flowered on peduncles longer than their diameter; bracts short, subulate: calyx nearly sessile, turbinate, equal, nearly glabrous, 10-nerved and reticulate; the teeth very short and surpassed by the dense, white, silky hairs fringing the inner margin: corolla purple, the tube twice longer than the calyx: middle lobe of the anterior lip little differing from the others: stamens very slightly exceeding the tube: style bifid, anterior lobe of the disk produced: calyx in fruit equal, patent: the mouth filled by the silky-ciliate fringe.—San José del Cabo; called by the inhabitants "Salvia por la Mesa."

469. Mentha Canadensis L.—Sierra de la Laguna.

470. Micromeria Brownei Benth.—This plant was collected at Juncal beyond the limits of the Cape Region.

471. Sphacele hastata Gray.—Sierra de la Laguna and Sierra de San Francisquito. There are two deserted old ranches in these high mountains, and in their immediate vicinity this plant is very abundant and seems to be

not certainly indigenous; at least it is not generally distributed about the high peaks. The species has been supposed to be peculiar to the Sandwich Islands, but though the habitats are widely separated Dr. Gray has noted *Abutilon incanum* as having a similar distribution. Dr. Watson has kindly sent specimens of the Sandwich Islant plant for comparison, and although there are slight differences they do not seem to warrant giving another specific name.

472. Salvia privoides Benth.—San José del Cabo, La Paz.

473. Salvia Cedrosensis Greene. — Sierra de la Laguna.

474. Brunella vulgaris L.—Sierra de la Laguna.

475. Stachys Drummondii Benth.—Sierra de la Laguna, San Bartolomé.

476. Stachys coccinea Jacq.—Common in the high mountains.

477. Plantago hirtella HBK.—Damp situations on the Sierra de la Laguna.

478. Plantago major L.—Wet situations in cultivated fields.

479. Mirabilis triflora Hartweg.—Limb of the corolla hardly spreading. A most handsome plant, bearing multitudes of flowers.—Sierra de la Laguna, Triumfo.

480. Mirabilis exserta. Herbaceous, 4–6 dm. high; lower stem glabrate upper part and inflorescence pubescent: leaves large, glabrous, cordate-ovate, acute or acuminate, the lower often 2 dm. long, on petioles about one-fourth their length; those of the inflorescence sessile, rounded and obtuse: flowers not congested; involucre 1-flowered, spreading, campanulate; the lobes ovate, obtuse, shorter than the cup: perianth white with a faint

pink shade, 5–6 cm. long, narrowly funnelform with spreading limb: stamens much exserted, about twice the length of the perianth: style exceeding the stamens: fruit 6–8 mm. in diameter, 10-sulcate, ovoid, or even depressed-globose in some specimens, scarcely thickened at base; surface smooth, dark-brown, marked with lighter flecks; involucre moderately enlarged in fruit.—Summits of the spurs of Sierra de San Francisquito.

481. ALLIONIA INCARNATA L. Flowers white. San José del Cabo and at La Paz.

482. ABRONIA MARITIMA Nutt.—Seashore at San José del Cabo and La Paz.

483. BOERHAAVIA SCANDENS L. *B. elongata* Brandegee. Todos Santos, San José del Cabo. Variable as to size and position of the glands upon the fruit. Flowers white tinged with purple.

484. BOERHAAVIA XANTI Watson.—San José del Cabo.

485. BOERHAAVIA ERECTA L.—San José del Cabo.

486. BOERHAAVIA VISCOSA Lagasca. Prostrate.—San José del Cabo.

487. BOERHAAVIA PANICULATA Rich. Becoming large and very diffuse.—San José del Cabo, Todos Santos.

488. POLYGONUM, sp. Near *P. Hydropiperoides*, but leaves thinner and broader; the sheaths with few ciliæ. Growing in shallow water.—Sierra de la Laguna.

489. ERIOGONUM ANGULOSUM Benth. Proc. Am. Acad., v, 167. Collected by Xantus at Cape St. Lucas.

490. ANTIGONUM LEPTOPUS Hook. & Arn. Common at low and middle elevations.

491. AMARANTUS PALMERI Watson. Very large and robust near La Paz.

492. AMARANTUS, sp. Male plants only and probably the same as *A. Torreyi* of the Xantus Collection.

493. AMARANTUS SPINOSUS L.—San José del Cabo.

494. AMARANTUS FIMBRIATUS (Gray).—San José del Cabo.

495. CELOSIA FLORIBUNDA Gray.—San José del Cabo, Todos. Sometimes forming small trees.

496. GOMPHRENA DECIPIENS Watson.—San José del Cabo, Todos Santos.

497. FRŒLICHIA FLORIDANA Moq.—Sierra de San Francisquito.

498. FROELICHIA INTERRUPTA Moq.—San José del Cabo.

499. IRESINE LANCEOLATA DC.?—Buena Vista, San José del Cabo, San Bartolomé, Sierra de la Laguna.

500. ATRIPLEX LINEARIS Watson.—La Paz.

501. CHENOPODIUM AMBROSIOIDES L.—Sierra de la Laguna.

502. CHENOPODIUM ALBUM L.—San José del Cabo.

503. RIVINA HUMILIS L. Common at Todos Santos and La Paz.

504. PHYTOLACCA OCTANDRA L.—Sierra de la Laguna.

505. PHAULOTHAMNUS SPINESCENS Gray.—San José del Cabo.

506. STEGNOSPERMA HALIMIFOLIA Benth.—San José del Cabo.

507. ARISTOLOCHIA KARWINSKII DC.? Agrees with the description as far as it goes, but neither the column, the stamens or the diaphragm are described.—San José del Cabo.

507. ARISTOLOCHIA, sp. A larger species belonging to the same section.—Sierra de la Laguna.

508. HOUTTUYNIA CALIFORNICA (Hook.) San José del Cabo.

510. PEPEROMIA UMBILICATA Ruiz & Pavon.—Sierra de San Francisquito.

511. LORANTHUS SONORÆ Watson ? Growing on Cyrtocarpa. Much larger than the described specimens.—San José del Cabo.

512. PHORADENDRON sp. Common throughout the southern half of the peninsula.

513. PEDILANTHUS MACROCARPUS Benth.—San José del Cabo.

514. EUPHORBIA ERIANTHA Benth. — San José del Cabo.

515. EUPHORBIA HINDSIANA Benth.—San José del Cabo.

516. EUPHORBIA HYPERICIFOLIA L.—San José del Cabo.

517. EUPHORBIA HETEROPHYLLA L. var. CYATHOPHORA Jacq.—Miraflores, San José del Cabo. Specimens from the first place have white seeds with a transverse depression, a solitary gland and the floral leaves are sometimes margined with white. Specimens from the second locality are smaller, the styles more deeply divided, glands five, seeds dark.

——— var. ERIOPHYLLA Millsp. Zoe, i, 348.—Sierra de la Laguna.

518. EUPHORBIA LEUCOPHYLLA Benth. This species is extremely variable as was shown by Engelman in his notes in Proc. Am. Acad., v, 168–170. *E. velutina* Greene Bull. Cal. Acad., ii, 57, is exactly the typical

form and probably from the same place, as there are in the Herbarium of the California Academy a very considerable number of fragments of plants, some with and some without labels, collected by W. J. Fisher and others, from San José del Cabo, Tres Marias and various other little known places on the western coast of Mexico. *E. biserrata* Millsp. Zoe, i, 347, cannot be considered anything more than a more glabrous variety at the northern limit of the species. Bentham notes, in the original description, that the leaves are "subsessilibus," "margine cartalagineo inæqualiter vel subduplicato-dentata." The flowers are solitary in the axils of the upper leaves of the branchlets. The seeds are white when dry, exactly the same in both forms, a very faint tinge of salmon showing through, but when wet the salmon color is pronounced. The leaves of the glabrous form have petioles perhaps a little longer, though this is more apparent than real, and due to the absence of the spreading tomentum; the division of the styles and the margin of the appendages is variable as in the type.

The species, both forms, grows in the clean sand of the seashore, never at any distance from it, and is undoubtedly perennial. The leaves even of the main stems are often imbricated, the nodes much shorter than the leaves, while in other plants growing beside them they may be three times as long and of quite a different appearance. The leaves in both forms have the obliquity of the base characteristic of the section Anisophyllum, the stipules variable and apparently unlike on the opposite sides of the stem.

519. EUPHORBIA XANTI, Engelm.—San José del Cabo, Todos Santos, La Paz.

520. EUPHORBIA POLYCARPA Benth.—San José del Cabo.

521. EUPHORBIA SETILOBA Engelm.—San José del Cabo.

522. EUPHORBIA WATSONII Millsp. Zoe, i, 347.—Todos Santos.

523. EUPHORBIA CALIFORNICA Benth. var.?—Todos Santos.*

524. EUPHORBIA BILOBATA Engelm.—Sierra de la Laguna.

525. EUPHORBIA VERSICOLOR Greene.—Todos Santos.

526. EUPHORBIA INVOLUTA Millsp. The specimens distributed under this name, at least the one which was sent the California Academy of Sciences is apparently identical with Palmer's No. 627 from Guaymas, 1887, distributed under the name *E. pediculifera* Engelm. var. *linearifolia* Watson.

527. EUPHORBIA TOMENTULOSA Watson.—La Paz.

528. EUPHORBIA PEDICULIFERA Engelm.—La Paz.

529. EUPHORBIA BLEPHAROSTIPULA Millsp. Contr. U. S. Nat. Mus., i, 77.

530. EUPHORBIA COMONDUANA Millsp. Contr. U. S. Nat. Mus., i, 77.

531. EUPHORBIA DENTATA Michx. var. LASIOCARPA Boiss.—La Paz. Con. U. S. Nat. Mus., i, 77.

532. EUPHORBIA, sp.—San José del Cabo.

533. EUPHORBIA, sp.—La Paz.

534. EUPHORBIA, sp.—Miraflores.

535. EUPHORBIA, sp.—San José del Cabo.

536. ADELIA, sp.?—San José del Cabo.

537. PHYLLANTHUS CILIATO-GLANDULOSUS Millsp.—La Paz, Todos Santos.

538. PHYLLANTHUS ACUMINATUS Vahl.? A small tree

*Zoe, i, 346.

with angled green branches seems to be this species. Seen only in the vicinity of Agua Caliente and Miraflores.

539. PHYLLANTHUS POLYGONOIDES Spreng.—Sierra de la Laguna.*

540. PHYLLANTHUS, sp.—San José del Cabo.

541. PHYLLANTHUS, sp.—Sierra de la Laguna.

542. EUPHORBIA (ANISOPHYLLUM) INCERTA. Perennial (?) glabrous, branching from the base, forming tufts about 2 dm. high and as broad: leaves all opposite, thick, coriaceous, entire, oblong, obtuse-mucronate, unequal at base, folding face inward, 6–10 mm. long, on the upper part of the branches equaling or exceeding the internodes; petioles about ¼ the length of the leaves; stipules persistent, oblong, nearly as long as the petioles, unequally incised into 2–4 lobes, one of them occasionally swollen below the tip: involucres angular, solitary in the axils on pedicels about as long as the petioles; lobes triangular-acuminate; glands four (the place of the fifth being occupied by a lacinate process), stipitate, concave, nearly orbicular, entirely without appendage; bracteolæ, lacerate: styles very short deeply bilobed: capsule declined; seeds ecarunculate, round-ovate, smooth, white, the angles obscure; cotyledons, ½ the length and little broader than the radicle.—La Paz on the spit opposite the town, growing in clean sand which forms a coating for the apparently glutinous stems their entire length, but does not adhere to the leaves or flowers.

543. SIMMONDSIA CALIFORNICA Nutt.—La Paz.

544. JATROPHA CANESCENS Müll.—Common at low elevations throughout the region. Variable in its pubescence and often glabrous.

545. JATROPHA CORDATA Müll.—Common at the higher elevations of the interior mountains.

*Zoe, i, 346.

546. Jatropha angustidens (Torr.)—San José del Cabo.

547. Jatropha spathulata.—San José del Cabo.

548. Croton Californicus Müll. Arg.—San José del Cabo and probably the western shore to Alta California.

549. Croton, sp.—San José del Cabo.

550. Manihot Carthagenensis Müll.—Common about San José del Cabo.

551. Bernardia Brandegei Millsp.—Common about San José del Cabo.

552. Bernardia myricæfolia Watson.—Sierra de la Laguna.

553. Bernardia, sp. Fruit only.—Comondu to San José del Cabo.

554. Acalypha aliena. Annual, erect, slender, 3–4 dm. high, minutely pubescent: leaves ovate-lanceolate, serrate, truncate at base, minutely punctate, nearly glabrous, 3–5 nerved, 2–6 dm. long; petioles slender, nearly as long as the leaves; stipules minute, linear, deciduous: spikes terminal and axillary. ♂ on slender peduncles, much shorter than the petioles; sepals caniculate, and glandular on the back: ♀ sessile, axillary ones short, terminal much longer; bracts punctate, loose, broadly ovate, 6 mm. long, serrate, acuminate or 2-toothed at apex, somewhat scarious at base; style filiform-dissected; capsule hispid above: seeds smooth, reddish-brown, the capsules of 1, 2 or 3 upper bracts divided to the base into three separate indehiscent nutlets, which are pubescent and muricate; the cotyledons of these abnormal cocci have the radicle inferior, the cocci being anatropous instead of the ovules.—San José del Cabo.

555. Acalypha Californica Benth.—San José del Cabo.

556. Argythamnia sericophylla Gray.—Collected by Dr. Palmer at La Paz.

557. Argythamnia lanceolata Müll. Arg.—Collected by Dr. Palmer at La Paz.

558. Argythamnia serrata (Torr.) — San José del Cabo.

559. Tragia nepetæfolia Müll.—Todos Santos.

560. Ricinus communis L.—San José del Cabo.

561. Ficus Palmeri Watson.—San José del Cabo, sometimes bearing aerial rootlets.

562. Quercus, sp.—Forming small trees about the summit of the Sierra de la Laguna, and not uncommon from Miraflores to the summit of the Sierra de San Francisquito.

563. Quercus, sp.—Extending from the summits of the Sierra de la Laguna to near the ocean at Todos Santos, Miraflores, Agua Caliente, etc. It is a large tree.

564. Populus Fremonti ?—San José del Cabo, Todos Santos.

565. Populus monticola Brandegee. Zoe, i, 274.*

566. Salix lasiolepis. Determined by Mr. Bebb.—Sierra de la Laguna.

567. Salix Bonplandiana HBK. var.—La Paz.

568. Pinus cembroides Zucc.—Common about the high summits of the mountains.†

569. Microstylis corymbosa Watson.—High mountains.

570. Microstylis montana Rothrock.—High mountains.

571. Microstylis, sp.—High mountains.

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*Garden and Forest, iv, 330, pl. 56.

†Garden and Forest, iv, 352, pl. 59.

572. SPIRANTHES MADRENSIS B. & H.? The specimens are much larger than No. 1372 of Pringle's Mexican plants of 1886 and are very young, not even bearing full grown flower buds.—High mountains of the interior.

573. HABENARIA, sp.—High mountains.

574. HABENARIA, sp.—High mountains.

575. EPIPACTIS GIGANTEA Dougl.—Sierra de la Laguna.

Two species of Orchidaceæ in mature fruit are undetermined.

576. PITCAIRNIA, sp.—San José del Cabo.

577. SISYRINCHIUM MINUS Engelm.—Sierra de la Laguna.

578. SISYRINCHIUM, sp. Near *S. Californica.*—Sierra de la Laguna.

579. ZEPHYRANTHES LONGIFOLIA Hemsley.—Collected at Rancho Salado, but not found within the Cape Region.

580. AGAVE AUREA Brandegee.—Todos Santos to La Paz.

581. AGAVE, sp. Flowers green with yellowish style and stamens.—Todos Santos, Santiago, La Paz.

582. BEHRIA TENUIFLORA Greene. Leaves several, shorter than the scapes, slender, from a fibrous coated corm, 2 cm. in diameter, scapes erect, not tortuous, much exceeding the leaves, 3–5 dm. in height. Flowers red with dark purple tips, 15–18 mm. long, exserted anthers green, pedicels jointed below the flower.

The specimens from which the original description was drawn had apparently flexuous stems, in these which are undoubtedly the same thing the stems are straight and erect. The genus is apparently nearest Brevoortia, also of a single species. In that genus the three filaments are adnate, but easily separable their whole length from the perianth, and alternate with the staminodia. In Behria the lower fourth of the perianth is adnate to the stipe of the ovary, but easily separable from it. The saccate portion is not therefore basilar as in Brevoortia in which the stipe is free. The basilar "crown" mentioned in the original description is not very apparent, the filaments being simply dilated at their point of union with the perianth.—Todos Santos, San José del Cabo to the summits of the high mountains.

583. Nolina Beldingi Brandegee, Zoe, i, 305.—High mountains of the interior.

584. Yucca baccata Torr. var.—*Y. valida* Brandegee is probably referable to some of the so-called varieties of this species.

585. Yucca caniculata Hook.? Growing in the mountainous region. The leaves are thin in texture, two to four feet long, bending downward, usually entire-margined, bright green, and giving to the plant a resemblance to Nolina. The fruit is that of *Y. baccata* and more or less beaked, maturing in January. The plants are two to ten feet high and rarely branched.

586. Commelina nudiflora L.—Growing along irrigating ditches of Todos Santos.

587. Commelina Virginica L.—San José del Cabo, Todos Santos.

588. Tradescantia crassifolia Cav.?—San José del Cabo.

589. Tradescantia venustula Kunth?—San José del Cabo.

590. Tinantia modesta. Branching, glabrous, 1 m. high: leaves elliptical-lanceolate, narrowed to a petiole, 8–12 cm. long, 2–3½ cm. wide, sparingly hirsute above,

glabrous below and finely ciliate on the margins; sheaths 3–4 mm. long, ciliate, cupulate: cymes terminal or rarely a small axillary one of 2–3 flowers, simple, scorpiod, 8–10 cm. long, unilateral for about one-half its length; pedicels 10–12 mm. long: fruiting calyx, 10 mm. long, the flowering much smaller: petals as long as the sepals: the three large stamens with glabrous filaments, the three smaller with bearded ones; anther cells nearly parallel, the connective broadest in the middle: capsule shorter than the calyx; cells 2-seeded.—Miraflores.

591. WASHINGTONIA SONORÆ Watson.—La Paz, San José. A species of Washingtonia is abundant in the cañons of the mountains and may be this one.

592. ERYTHEA ARCUATA Watson. In fruit among the high mountains. The palms were found abundant in the Sierra de San Francisquito and very few about the Sierra de la Laguna.

593. PISTIA STRATIOTES L. var. SPATHULATA (Mich.) —San José del Cabo.

The synonymy of this wide spread species, is given by Engler in Suites au Prodromus, vol. ii, 634–636.

594. LEMNA, sp.—Sierra de la Laguna.

595. ECHINODORUS ROSTRATUS Engelm. In standing water, San José del Cabo.

596. POTAMOGETON, sp.—Sierra de la Laguna.

596½. POTAMOGETON sp.—Sierra de la Laguna.

597. ELEOCHARIS CAPITATA R. Br.—San José del Cabo.

598. ELEOCHARIS PALUSTRIS R. Br. ?—Sierra de San Francisquito.

599. CYPERUS, sp.—San José del Cabo.

600. CYPERUS, sp.—Sierra de San Francisquito.

601. CYPERUS ARISTATUS Rottb.—San José del Cabo.

602. CYPERUS, sp.—San José del Cabo.

603. SCIRPUS PUNGENS Vahl.—San José del Cabo.

604. ERIOCHLOA PUNCTATA Hamil.—San José del Cabo.*

605. PASPALUM DISTICHUM L. var. LITTORALE R. Br.—San José del Cabo.

606. PANICUM FASCICULATUM Willd. var. DISSITIFLORUM.—San José del Cabo, Todos Santos.

607. PANICUM SANGUINALE L.—San José del Cabo.

608. PANICUM BARBINODE Trin.—Collected at La Paz by Dr. Palmer.

609. PANICUM COLONUM L.—San José del Cabo.

610. PANICUM CRUS-GALLI L.—San José del Cabo.

611. PANICUM PASPALOIDES Pers.—San José del Cabo.

612. ORTHOPOGON HUMBOLDTIANUS Nees.—Miraflores.

613. SETARIA PAUCISETA Vasey—191 Palmer's Mexican Collection, 1885.—San José del Cabo.

614. SETARIA GLAUCA Beauv. var. LÆVIGATA Chap.—San José del Cabo.

615. SETARIA CAUDATA R. & S. Growing tall among bushes.—San José del Cabo.

616.—CENCHRUS PALMERI Vasey.—Colllected at La Paz by Dr. Palmer.

617. CENCHRUS TRIBULOIDES L.—San José del Cabo.

618. ÆGOPOGON GRACILIS Vasey.—Sierra de San Francisquito.

619. MANISURIS GRANULARIS Swartz.—Sierra de San Francisquito.

* The grasses were determined by Dr. George Vasey.

620. Trachypogon polymorphus Hook.—Sierra de San Francisquito.

621. Heteropogon acuminatus Trin. — Sierra de San Francisquito.

622. Hetropogon contortus R. & S.—San José del Cabo, La Paz.

623. Andropogon melanocarpus Ell.

624. Andropogon hirtiflorus Kunth.—Sierra de San Francisquito.

625. Aristida Scheidiana Trin. — Sierra de San Francisquito.

626. Aristida Orcuttiana Vasey.—Todos Santos, San José del Cabo.

627. Aristida Californica Thurber, var. glabrata. Differs from the type in its larger size, more spreading and branched habit and shorter awned flowering glumes, yet appears to be too near for a new species. It has the awn jointed to the glume.—San José del Cabo, Todos Santos.

628. Aristida dispersa Trin.—Collected at La Paz by Dr. Palmer.

629. Aristida tenuis Kunth.—San José del Cabo.

630. Muhlenbergia grandis Vasey.—Sierra de San Francisquito.

631. Muhlenbergia debilis Trin.—Dr. Palmer at La Paz.

632. Perieilema crinita Presl. — Sierra de San Francisquito.

633. Sporobolus Wrightii Thurb. ? Specimens too old. San José del Cabo.

634. Chloris elegans HBK.—Dr. Palmer at La Paz.

635. BOUTELOUA POLYSTACHYA Benth. A form.—San José del Cabo.

636. BOUTELOUA RACEMOSA Lag.—San José del Cabo.

637. BOUTELOUA HIRSUTA Lag.—Sierra de San Francisquito.

638. BOUTELOUA OLIGOSTACHYA Torr.? Too young.—San José del Cabo.

639. BOUTELOUA BROMOIDES Lag.—Miraflores.

640. BOUTELOUA ARISTIDOIDES Thurber.—San José del Cabo.

641. ELEUSINE INDICA Gaert.—San José del Cabo.

642. DACTYLOTÆNIUM ÆGYPTIACUM Willd. — San José del Cabo.

643. RHACHIDOSPERMUM MEXICANUM Vasey. With good specimens of the male plant I see no reason to think this *Jouvea* of Fournier.—In the sand along the coast. Todos Santos, San José del Cabo, La Paz.

644. DIPLACHNE IMBRICATA Thurb.—Collected by Dr. Palmer at La Paz.

645. DIPLACHNE BRANDEGEI Vasey. Older than the specimens of 1889—the branches reflexed.—San José del Cabo, Todos Santos.

646. ARUNDO DONAX L.—Probably introduced, but it is difficult in some places to determine, as in Texas and New Mexico along the Rio Grande.—San José del Cabo. Todos Santos.

647. MONANTHOCHLOE LITTORALIS Engelm. — La Paz.

648. ERAGROSTIS SPICATA Vasey. — San José del Cabo, Todos Santos.

649. ERAGROSTIS MAJOR Host. Variety.—San José del Cabo.

650 ERAGROSTIS CILIARIS L.—San José del Cabo.

651. Eragrostis ciliaris L. var. patens Chap.—San José del Cabo.

652. Eragrostis Purshii Schrad.—Collected by Dr. Palmer at La Paz. Cont. U. S. Herb., iii, 78.

653. Polypodium plebium Schl.* The form with obtuse segments like Parry & Palmer's No. 973 from San Luis Potosi. Except for the scales on the frond this has very much the look of *P. vulgare*.—Sierra de la Laguna.

654. Polypodium plesiosorum Kunze? A single frond, not very typical of this species, but better placed here than elsewhere.—High mountains of the interior.

655. Gymnogramme trifoliata Desv.—Growing in the hedges at Todos Santos.

656. Notholæna nivea Desv. A large and stout form like some from Chiapas collected by Ghiesbrecht.—Sierra de la Laguna.

657. Notholæna candida Hooker.—Sierra de la Laguna.

658. Notholæna ferruginea Hooker.—Sierra de la Laguna.

659. Notholæna Lemmoni D. C. Eaton.—Todos Santos, La Paz.

660. Cheilanthes Pringlei Davenp.—The specimens differ from the type in having longer fronds with more distant pinnæ, and the pinnules oblong rather than ovate. The fronds, too, are rather less scaly along the rachises. Possibly they should be described as a distinct species, but some of Palmer's specimens from Chihuahua (No. 116 of 1885) seem to connect them with the original form from Arizona.—Cañons along the base

* The determination of the ferns and the accompanying notes are by Prof. D. C. Eaton.

of the mountains and in the hills about Todos Santos and San José del Cabo.

661. Pellæa marginata, var. pyramidalis Baker. Sierra de la Laguna.

662. Pellæa ternifolia Fée. Very fine and large specimens.—Common in the Sierra de la Laguna.

663. Pellæa Seemanni Hooker. The form with broad pinnules, like Palmer's No. 226 of 1887, from Guaymas.—Foothills near Agua Caliente.

664. Adiantum concinnum HBK.—Sierra de la Laguna.

665. Adiantum Capillus-Veneris L.—A single rather large frond, the pinnules like those of examples from Santa Barbara, not much lobed.—Sierra de la Laguna.

666. Asplenium blepharodes D. C. Eaton, Zoe, i, 197.—Sierra de la Laguna.

667. Aspidium patens Swartz.—Summit of the high mountains.

668. Aspidium Mexicanum Presl. A form with narrow segments, the same as that gathered in the Huachuca mountains of Arizona, Lemmon in 1882, and in Jalisco by Palmer and by Pringle.—High mountains.

669. Woodsia Mexicana Fée. This has the indusium cleft into a few broad segments, but much more delicate and evanescent than in *W. obtusa*, which it somewhat resembles in the shape of the fronds.—High mountains.

670. Aneimia hirsuta Swartz. This has also been collected by both Palmer and Pringle.—Mountains.

671. Ophioglossum vulgatum L. The ordinary form of the North Temperate Zone.—Common in the high mountains.

672. SELAGINELLA RUPESTRIS Spring. A long and slender, branching form, the stems sub-terete; leaves gradually narrowed into the straight terminal seta; cilia 15–20 each side of the leaf. It is the same as Palmer's No. 92 from San Miguel, Chihuahua.—Growing in the mountains.

673. SELAGINELLA CUSPIDATA Link.—Common in the mountains.

674. ISOETES MEXICANA Underw.*—Sierra de la Laguna.

675. POLYTRICHUM PILIFERUM Schreb.?—In the high mountains.

676. WEBERA LONGICOLLA Hedw. High mountains.

677. CYLINDROTHECIUM CLADORRHIZANS Schimp.—High mountains.

678. FIMBRIARIA ECHINELLA Gottsche.—Mountains.

679. ANTHOCEROS LÆVIS L.—Mountains.

Encelia eriocephala Gray and *Hesperocallis undulata* Gray, credited to Cape St. Lucas in a previous paper, do not appear to belong to the region. It is probable that there was some confusion of labels.

No. 179 of Palmer's Guaymas collection, which was described by Dr. Watson from imperfect material, grows commonly at lower elevations, in the Cape Region, but female flowers and perfect fruit have not yet been obtained. It flowers April–May, and although an abundance of the male flowers have been sent by correspondents, they seem unable to find the female.

Several plants are not included in the above list, having been collected in a state which does not admit of even generic identification.

* This and the following species were determined by Prof. L. M. Underwood.

ON THE PROTHALLIUM AND EMBRYO OF MARSILIA VESTITA.

BY DOUGLAS HOUGHTON CAMPBELL.

In studying the evolution of the higher cryptogams, perhaps the most striking peculiarity noticed is the progressive reduction of the sexual generation. This has evidently gone on along several distinct lines, and has resulted in at least one of them in the production of seed-bearing plants (spermaphytes), or as they are more popularly called, phanerogams. Whether or not all the spermaphytes have had a common origin it is not the purpose of the present paper to discuss.

As we survey the great group of Pteridophytes we find remnants among our living flora of four groups where the preliminary step toward the formation of seeds has been taken, but there is strong reason to believe that in two, at least, of these, the process has not gone any further. This preliminary step is heterospory or the formation of two sorts of spores, large and small, giving rise respectively to female and male prothallia. These are very much reduced, and sometimes almost completely included within the spore.

Among living Pteridophytes, as already stated, are four groups in which heterospory is present, viz: Marsiliaceæ, Salviniaceæ, Selaginelleæ, and Isoeteæ, all of which are represented in the flora of California. It is with the first of these that we have to deal here.

The Marsiliaceæ, including the two genera Marsilia and Pilularia, are widely distributed species occurring in the warm and temperate regions of nearly the whole earth. These plants are remarkable for the extraordinary rapidity with which the germination takes place, and, in Marsilia, for the length of time that the spores retain their vitality. For studying the germination, species which grow where they become entirely dried up after the spores ripen, are best. Species like *M. quadrifolia*, which is strictly aquatic, are more difficult to germinate. *M. vestita*, the common species of California, has proved a most satisfactory form for study. Through the kindness of Mrs. Brandegee a plentiful supply of ripe fruits of this species was placed at my disposal, and it was possible for me to trace the development of the prothallium and embryo in a most satisfactory manner.

The earliest works on the Marsiliaceæ are extremely imperfect and will not be further referred to. Hofmeister * was the first to recognize the real affinities of these plants, but his accounts leave much to be desired. The first account that was in any sense complete was that of Hanstein,† which threw a good deal of light on the development of both the prothallium and embryo, but in regard to the former was very far from correct. Owing to his methods of treating the delicate prothallium with potash and other clearing agents, much of the structure was destroyed, and very erroneous conclusions were reached. Later, Arcangeli ‡ and Sadebeck § corrected some of the worst mistakes, and the writer || later, with the aid of more perfect modern histological methods, was

* Hofmeister. The Higher Cryptogamia, pp. 325-327.

† Hanstein. Die Befruchtung und Entwicklung der Gattung Marsilia (Jahrbuch für Wiss. Bot. 1865).

‡ Arcangeli. Sulla Pilularia e Salvinia (Nuovo Giornale botanico Italiano, vol. viii, 1876).

§ Sadebeck, in Schenck's Handbuch der Botanik, vol. i, p. 238.

|| Campbell. The development of Pilularia globulifera (Annals of Botany, vol. ii, No. viii, Nov., 1888. Campbell—Einige Notizen über die Keimung von Marsilia Ægyptiaca—Berichte der Deutschen botanischen Gesellschaft, 1888.

able still further to advance our knowledge of the early stages. Still there were several points in regard to Marsilia that were obscure, especially the first divisions in the prothallia, and these it was possible to clear up by a study of the material at my disposal.

THE FRUIT.

The sporangia of the Marsiliaceæ are formed within peculiar "fruits" which are modified segments of the leaves, bearing much the same relation to the sterile portion that the fertile segments of the leaves of Botrychium or Osmunda do to the sterile ones. These sporocarps in *M. vestita* (pl. III, fig. 1), are bean shaped, very hard bodies, about five mm. in length, and attached to the base of the petiole. They are more or less hairy, whence the specific name. These fruits open spontaneously when perfectly ripe, if placed in water, but the process is comparatively slow and may be hastened by cutting away enough of the hard outer shell of the fruit to expose the yellowish inner tissue. This latter is of a mucilaginous nature, and on the absorption of water swells up enormously and causes the two halves of the fruit to separate as two valves. The gelatinous inner tissue of the fruit continues to expand as more water is absorbed, and finally forms a long worm-shaped body, sometimes eight or ten cm. in length. To this are attached the sori, each surrounded by a sac-shaped indusium, in which the sporangia are closely packed (pl. III, fig. 2). Both sorts of sporangia occur in the same sorus. Each macrosporangium contains a single very large macrospore; the microsporangia numerous much smaller microspores. If care is taken in opening the fruit, the indusium remains intact for several hours, and this was found a great help in the study of the microspores, as the whole sorus could be handled, and imbedded, and sections made, which would, of course, have been out of the question were the microspores allowed to become entirely separate. Gradually, however, the walls of the indusium soften and most of the spores are forced out into the water by the swelling of the mucilaginous matter that surrounds them.

The structure of the fruit and the development of the sporangia and spores have been exhaustively studied by Russow,* and it is only necessary to state here that up to a late stage of development, the sporangia and spores develop alike in the two sorts of sporangia, but that later in the macrosporangium one of the young spores finally grows at the expense of the others, which are gradually absorbed by it in its growth, and finally fills the whole sporangium. In the microsporangium, all of the original sixty-four spores come to maturity.

In studying the spores they were first treated for about two hours with a 1 per cent. aqueous solution of chromic acid, and after repeatedly washing in distilled water to remove as much of the acid as possible, were gradually brought into 95 per cent. alcohol where they were allowed to remain until wanted. By this means the acid was completely removed, and they stained readily with cochineal or carmine solution, which will not act satisfactorily if any acid is left in the specimens. After staining with alum-cochineal, the specimens were dehydrated, imbedded in paraffine, and cut with a Minot microtome. Before finally mounting, they were further stained on the slide with Bismarck brown (in 70 per cent. alcohol) and mounted in Canada balsam. Specimens thus treated show very beautifully all the details of cell-division, and enabled me

*Russow. Histologie und Entwickelungsgeschichte der Sporenfrucht von Marsilia. Dorpat, 1871.

to determine with great precision every step in the formation of the prothallium and embryo.

THE MICROSPORES AND MALE PROTHALLIUM.

The microspores of *M. vestita* are globular cells about .075 mm. in diameter. The outer wall is white and sufficiently transparent to allow the contents of the spore to be dimly seen through it. Its surface presents a punctate appearance, and at one point there are three lines which meet each other at equal angles and mark where the spore was in contact with its three sister-spores in the mother-cell (pl. III, fig. 3). Lying close to the inner surface of the wall may be clearly seen numerous distinct starch granules, and in the center the nucleus is vaguely discernible; covering the outside of the spore is a thin structureless mucilaginous layer, which, however, is scarcely perceptible in microtome sections.

Sections through the ungerminated spore show that the wall is thick and has several distinct layers. The innermost is thin and delicate, and is probably composed of cellulose. The second is thicker and more or less cuticularized, and the outer wall (epispore) is thick and apparently composed of prismatic rods placed close together (pl. III, figs. 5 and 6). A surface view of the epispore shows that it is the ends of these prismatic rods that give the punctate appearance already noted. This outer coat may be easily removed by mounting the fresh spores in a drop of water and covering with the ordinary cover glass, which is then rubbed carefully to and fro. The smooth, colorless and semi-transparent exospore is then seen, but it is not possible to get a satisfactory view of the interior of spores thus treated. In the later stages by boiling upon the slide, especially if a little potash is added to the water, the exospore may be ruptured, and with care, the young prothallium surrounded only by the transparent endospore, may be liberated; but it is so delicate, and the walls are so swollen by this process, that the study of their arrangement is exceedingly difficult, and it was found necessary to devise some means by which the spores could be sectioned. This was finally accomplished by taking the whole sorus and imbedding it. Of course, by so doing it is impossible to regulate the direction in which the sections are made, but the number of spores is so great, that some of them are almost certain to show satisfactorily the desired stages.

Occupying the center of the spore is a large and distinct globular nucleus. Usually one or more nucleoli are present, and the chromatin seems to be fairly abundant. The cytoplasm shows a more or less reticulate arrangement, as if there were large vaculoles which are distributed pretty uniformly throughout the spore. Granules of various sorts are abundant, some of them, especially near the periphery, being the large starch granules already referred to, the others being apparently of albuminous nature (pl. III, fig. 4).

The first divisions occur under proper conditions in about an hour after the spores are placed in water. Previous to this the nucleus enlarges somewhat and passes to one side, usually the side opposite the apex, and the granules of the protoplasm accumulate near the center of the spore, leaving a more or less clearly defined zone in which the granules are much less numerous. The central granular mass, however, has running from it lines of granules extending to the periphery of the spore (pl. III, fig. 7).

The first wall divides the spore into two very unequal cells, the smaller containing but little granular contents, and representing the vegetative part of the prothallium.

the upper is the mother cell of the antheridium (pl. III, fig. 8). The size of this vegetative cell (x) varies a good deal in different cases. In the earliest accounts of Marsilia this cell was overlooked, but Sadebeck * demonstrated it later. In Pilularia † there is in addition a smaller one that is frequently found. The next division differs in different cases, but usually is effected by a wall approximately parallel to the first one, but more or less concave upward, being in fact the homologue of the first funnel-shaped wall found in the antheridium of the Polypodiaceæ (pl. III, fig. 9), and the lower cell, which has very little granular contents, corresponds to the lower ring-cell of the wall of the ordinary fern antheridium. Sometimes, however, the antheridium mother-cell divides at once by an oblique wall into two nearly equal cells, which indicate the position of the two groups of sperm-cells found in the older antheridium. In no case observed was there certain indication of the formation of a perfect dome-shaped wall in the upper cell of the antheridum such as occurs regularly in the homosporous leptosporangiate ferns, and also, as a rule, in the nearly related but less specialized Pilularia.

The formation of this wall seems to have been partially lost as a result of the extremely rapid development of the antheridium, and the separation of the groups of sperm-cells takes place by the formation of cells, cut off in a more or less irregular manner from the periphery of the two cells into which the upper cell of the antheridium is at first divided. The cap-cell, at the top of the antheridium (pl. III, fig. 13, d) is almost always plainly visible, so that the only difference between the normal develop-

*Schenk's Handbuch, vol. i, p. 238.

†Campbell, l. c. p. 238.

ment of the antheridium of Marsilia and that of the ordinary Polypodiaceæ, is in the imperfect development of the dome-shaped cell by which in that group the central cell of the antheridium, from which the sperm-cells later arise, is at once completely separated from the outer wall of the antheridium mother-cell.

In Marsilia the contents of the central cells show a distinct separation into a granular inner and a nearly transparent outer part, and the boundary between the two is often sharply marked before any actual division has taken place (pl. III, fig. 12).

From the two cells into which the central part of the antheridium is now divided, a varying number of sterile cells are cut off, which are transparent, and more or less completely surround the two central cells which are at once distinguished by their densely granular contents. Not infrequently (pl. III, figs. 17 and 18), a sterile cell is formed between these, completely separating them, and extending entirely across the antheridium. Sometimes, as in the cases figured, this is followed by two walls formed simultaneously that run parallel with the outer wall of the antheridium, and reach to this central sterile cell. In such cases, a cross section of the two cells which are to give rise to the sperm-cells is very symmetrical and nearly semicircular in outline. This regularity, however, while very frequent, does not always occur, and the peripheral cells may be cut off apparently without any regularity (pl. III, fig. 19). After the sperm-mother-cells are differentiated, however, the divisions in them show great regularity. Each one divides into two nearly equal cells by a vertical wall (pl. III, fig. 18), and this is then followed by a horizontal wall. The next division is vertical, and each of the resulting eight cells then divides once more, making sixteen in each group of sperm-cells, or thirty-two in the whole antheridium. The whole division in *M. vestita* may be completed within about seven hours from the time the spores are placed in water, and the formation of the spermatozoids begins about an hour later and appears to require about four hours for its completion.

The full-grown prothallium (pl. III, fig. 20) appears very different when seen from different sides. A median vertical section, passing through both groups of sperm-cells, shows usually the small vegetative cell (*x*), above this the broad basal cell of the antheridium (*m*), and above this the two clearly marked oval groups of sperm-cells, sometimes in contact, sometimes separated by a sterile cell, and separated from the outer wall of the antheridium by the lateral sterile cells (*p*) and the cover cell (*d*). If a vertical section is made at right angles to the one just described, only one of the groups of sperm-cells will be seen, and the lateral peripheral cells appear much broader (pl. III, fig. 20, *b*). A cross section of the antheridium shows the two symmetrical groups of sperm-cells, as shown in fig. 20, *c*.

The walls of the sperm-cells are exceedingly delicate, but perfectly evident, especially when the contents are contracted, a case that happens very frequently, especially after the spermatozoids begin to form.

In the early stages of the prothallium and antheridium, the nuclei are large and very distinct but with comparatively little chromatin, so that although dividing nuclei were often met with, the figures were very small and not easily studied. In the sperm-cells, previous to the formation of the spermatozoids, the nuclei are less readily seen, owing to the readiness with which the cytoplasm takes up stains, and consequently Marsilia does not afford a very satisfactory subject for the study of the development of the spermatozoids, and this point was only observed in a very casual way. Nothing was observed, however, which pointed to anything peculiar in their origin. As in other cases observed, the body of the spermatozoid is derived from the nucleus of the sperm-cell by its direct change in form. It first contracts on one side and forms a thick curved band (pl. III, fig. 21) which then lengthens out and becomes thinner and many times coiled until it has assumed the corkscrew form of the full-grown spermatozoid. The cilia and the vesicle which is attached to the hinder end are derived from the cytoplasm.

When the antheridia are ripe, which ordinarily takes place in about twelve or sixteen hours after the spores are placed in water, the cells forming the walls become very much distended by the rapid absorption of water, and in consequence of the pressure from within the exospore breaks open along the lines of the three radiating ridges at the apex, and the upper swollen cells of the antheridia protrude through the opening. Finally the peripheral cells are torn apart, and the sperm-cells with the contained spermatozoids are discharged. The walls of the sperm-cells are soon completely dissolved and the spermatozoids are thus set free.

The spermatozoids of Marsilia are distinguished from all others by the great number of coils in the spiral body. In the species under consideration there may be thirteen or fourteen. In the active condition (pl. III, fig. 22, *a*) the coils are close together and the lower coils much wider. When the movements begin to slacken, or when the body is held in the mucilaginous matter about the macrospore, the spiral often becomes much elongated (pl. III, fig. 22, *b*). The very numerous long cilia are attached mainly to the lower coils, and the upper pointed end seems to be quite free from them. When the spermatozoid escapes from its mother-cell there is attached, as in other spermatozoids, a delicate vesicle (*v*) containing more or less granular matter. Some of the granules are starch, others seem to be albuminous. This vesicle usually becomes detached when the spermatozoid is held in the mucilaginous matter about the macrospore where they accumulate in very large numbers, hundreds often being visible about a single macrospore. Evidently this mucilaginous matter exercises an attraction apart from that thrown out by the ripe archegonium, as they collect about the macrospore long before the archegonium has opened. In studying them, they were killed with a drop of weak osmic acid about ¼ per cent., and then stained with a little gentian-violet. In this way they may be killed instantly without any distortion and the cilia rendered very distinct.

If we compare now the antheridium of Marsilia with that of the other Filicineæ we find, as might be expected, the nearest affinity with Pilularia, from which it differs mainly in the less perfect development of the dome-shaped wall in the antheridium mother-cell, and the more distinct separation of the two groups of sperm-cells, which, as we have seen, are here remarkably distinct. In Pilularia these remain distinguishable up to the time that the antheridium is ripe, but this is less marked than in Marsilia. In the Polypodiaceæ, which are the nearest among the homosporous ferns to the Marsiliaceæ, this division is indicated in the early stages of the antheridium, but is finally lost.

THE MACROSPORE AND FEMALE PROTHALLIUM.

The macrospore of Marsilia is the most specialized found in the Pteridophytes. This is true both of the peculiar wall, which however it shares with the nearly related Pilularia, and the segregation, even in the ungerminated spore of the protoplasm which is to form the prothallium. The spores are very large ellipsoidal cells, about .425 x .750 mm. in diameter. They are ivory white in color and covered with a slimy mucilaginous coating of considerable thickness. The upper end of the spore has a hemispherical protuberance covered with an evidently thinner brownish membrane, and it is the protoplasm within this that alone gives rise to the young prothallium. In cross sections it is plainly seen that the upper end of this proturberance shows three radiating lines corresponding to those at the apex of the microspore, and like them indicates where the spore was in contact with the three sister-spores in the mother cell.

Sections of the ungerminated spore (pl. IV, fig. 1), show structures very like those in the microspore but more strongly developed. The most noticeable difference is in the distribution of the contents. Instead of having these uniform as in the microspore, here the protoplasm filling the proturberance at the top is finely granular and free from the large starch grains that occur in the body of the spore. This dense protoplasm, too, colors strongly with various staining agents, and the line of demarkation is abrupt. The nucleus of the spore is situated in the center of the apical protoplasm which, however, is not separated by a membrane from the body of the spore. The nucleus is more or less strongly flattened, but this is exaggerated when the protoplasm at the apex has contracted, as it often does during the process of imbedding. The protoplasm of the body of the spore is arranged reticulately and probably in the living spore contains vacuoles and oily matter which is removed in the process of imbedding. Granules of various sizes, partly albuminous, and partly starch, are abundant.

The grains of starch are especially large and conspicuous. The wall of the spore shows much the same structure as that of the microspore, but the peculiarities are more marked. The epispore is especially well developed and differs mainly from that of the microspore in the prisms of which it is composed being in close contact and appearing in surface view as polygonal areas in close apposition. Outside of the epispore proper the structureless mucilaginous outer epispore forms a more or less conspicuous layer. It stains deeply and is especially developed toward the upper part of the spore. This layer is not shown in figures 1 and 12.

A very full account of the structure of the cell, as well as their development, is given by Strasburger.*

The development of the female prothallium is somewhat slower than that of the male, and ordinarily takes fifteen to twenty hours for its completion, although if the temperature is high it may be completed in somewhat less time.

The first sign of germination is an increase in the size of the hemispherical mass of protoplasm at the apex of the spore, and the boundary between it and the body of the spore becomes somewhat less decided (pl. IV, fig. 2). At the same time the nucleus becomes more nearly globular, and its contents, which in the ungerminated spore appear almost uniformly granular, become somewhat different. The granules become larger, and some of them stain more deeply, showing them to be chromatin bodies (pl. IV, fig. 4). At no time, however, is the amount of chromatin large. The first division was not observed in any spores that had been in water for less than two hours, and probably very seldom occurs sooner than this. Usually,

*Strasburger. Über den Bau und Wachsthum der Zellhaüte, pp. 123-133.

but not always, the first wall cuts off the papilla at the top of the spore from the cavity below (pl. IV, fig. 5). The nuclei of the two cells are very unequal in size, the lower one being much smaller. Both are strongly flattened and the division wall is very convex, and a small part of the fine granular protoplasm of the papilla is usually cut off from below and remains in the lower cells. The lower large cell takes no further part in the formation of prothallium and remains with very little change until after the fertilization of the archegonium.

The next division in the upper cell is usually a nearly vertical wall which cuts off a small peripheral wall (pl. IV, figs. 6 and 7), and this is followed later by usually two similar ones (fig. 10, ii and iii), which, with the first formed enclose a large central cell, the mother-cell of the archegonium. On comparing this stage with the same one in Pilularia, we find that in the latter the peripheral cells are not formed until a second wall, parallel to the basal wall is formed, and, as a rule, but two walls are formed instead of three in the cutting off of the archegonium mother-cell. That this difference is not essential, however, is seen from the fact that occasionally in Marsilia the basal cell is formed before the peripheral cells are all cut off (pl. IV, fig. 9).

A variation occasionally met with was the cutting off of a lateral cell before the separation of the prothallium from the body of the spore.

Generally, before the second peripheral is cut off, the first formed one has already divided by a vertical wall into two small parts (pl. IV, fig. 7). At this stage the prothallium, exclusive of the body of the spore, consists of a large central cell, the mother-cell of the archegonium (fig. 10, *o*), and three peripheral cells (*p*) which have undergone more or less further division. The archegonium mother-cell behaves in all respects like that of the ordinary ferns. It divides first into a lower or basal cell, which forms later a single layer of cells, separating the central cell of the archegonium from the spore cavity, and a much larger upper one which forms the archegonium proper. The basal cell divides into two nearly equal cells, and each of these by a similar wall, so that a cross section of the base of a prothallium of about seven hours (fig. 10, *b*) shows this cell divided into nearly equal quadrants. While this division is progressing in the basal cells, the peripheral cells are also dividing by both vertical and horizontal walls, but only in two planes, so that the central cell is invested on all sides by a single layer of cells. These contain small but distinct nuclei and more or less granular contents, and after fertilization develop more or less chlorophyl.

From the top of the central cell is now cut off a shallow cell which later divides into four by two cross walls, very much as the basal cell divides, and this forms the beginning of the neck of the archegonium (pl. IV, fig. 11, *n*). These cells do not at first project, but a little later increase somewhat in size and each becomes divided by an oblique wall into two cells, of which the upper ones become strongly turgescent and project in the form of a papilla beyond the ruptured exospore, which is broken through at about this stage (pl. IV, fig. 12). About the same time that this division takes place in the next cell, a small cell is cut off from the central cell, and forms the next canal cell (fig. 12, *c*), and very soon after a second smaller one (fig. 13, *b*), and very soon after this the contents of the central cell contract to form the egg, and its walls as well as those of the canal cells become disorganized. The egg at this stage shows a clear space at the top, the receptive spot (fig. 13, *r*), and the nucleus although distinct is unusually small.

The opening of the archegonium is brought about by the swelling of the neck cells combined with the pressure exerted by the swollen mass produced by the disintegration of the canal cells, which are forced out more or less completely as the archegonium opens, and thus a channel is formed down to the egg.

Owing to the small amount of chromatin in the egg nucleus, and the strong staining of the cytoplasm, it was found impracticable to attempt a careful study of the fertilization.

The mucilage about the spore often forms a sort of funnel-shaped cavity above the archegonium, and in this and the surrounding mucilage the spermatozoids assemble in immense number, and as soon as the archegonium opens they collect in such numbers about it that its opening is often completely choked up. Several of the first comers usually succeed in penetrating to the central cell, but probably as in other cases where this has been carefully studied, only one enters the egg. Here it soon unites with the egg-nucleus, which has in the meantime increased in size and moved towards the receptive spot.

As soon as fertilization is effected the egg secretes a membrane about itself, which effectually prevents the entrance of other spermatozoids. At the same time the inner membranes of the neck cells assume a dark brown color. With the first division in the fertilized egg, a division begins in the cells of the prothallium, which changes the single layer of cells enveloping the egg into a double layer, except in the basal cells which undergo no further division (pl. IV, figs. 15 and 16). The lower may divide further so that here the prothallium may become several cells thick. and the surface cells may grow out later into root-hairs.

THE EMBRYO.

The embryo was very carefully studied by Hanstein,* and as his account is in all important particulars correct, I shall simply give here a brief sketch of the earlier divisions, as only a few minor differences were noted between *M. vestita* and *M. salvatrix*, which was the species mainly studied by Hanstein.

The first division of the fertilized egg takes place probably within two or three hours after the entrance of the spermatozoid, but I have no exact data on this point. Hanstein says that in the case of *M. salvatrix* about twelve hours elapse before the first division, but in *M. vestita* the time is certainly much shorter. The first wall is a vertical one and divides the embryo into two equal cells. This is followed quickly by a nearly horizontal one in each cell, at right angles to the first, and this second division divides the embryo into primary organs. The first or basal wall, divides the embryo into the "epibasal" or forward, and the "hypobasal" or posterior parts, and the second walls divide the epibasal portion into cotyledon and stem, and the hypobasal into root and foot.

The third set of walls "octant walls," are not quite the same in the two walls of the embryo, in the epibasal quadrants the octant wall is at right angles to the others, and the resulting cells consequently equal, but in the hypobasal quadrants this is not the case, but the octant walls make an angle of about 120° with the basal wall, so that the octants are of very unequal size.

The eight cells of which the embryo is now composed, while somewhat unequal in size, are approximately of the same form, *i. e.* tetrahedral, and one of the cells from

*l. c. p. 28.

the first, in each quadrant, may be looked upon as the permanent apical cell of the organ derived from it. In the cotyledon and stem, this does not always appear to be the same one, but in the root it is always the larger of the two octant cells. The next division is the same in all the octants except the two smaller ones of the hypobasal half of the embryo, and consists of a curved wall which divides them into two cells, which appear respectively triangular and quadrilateral when seen from the side. We may say that the triangular cell is the apical one and the four-sided one its first segment (pl. IV, fig. 16).

THE COTYLEDON.

In a cross-section of a very young embryo, the two halves of the leaf quadrant appear exactly the same, and it is impossible to say which of the two apical cells becomes the definite apical cell of the young leaf; but soon one of these ceases to divide with any regularity and the other grows more rapidly, divided by regularly arranged segments, and functions, for a time at least, as the apical cell of the young cotyledon (pl. IV, fig. 18, *a*, L^x). How long this continues was not further investigated, and not infrequently the definite apical growth ceases at a very early stage, as figured by Hanstein for *M. salvatrix*, and as frequently happens in Pilularia.

THE STEM.

The first divisions in the stem quadrant follow closely those in the cotyledon, but here only one octant properly goes to form the stem apex, and the other gives rise to the second leaf, which grows at first in a manner entirely similar to that of the stem, but about the time that the cotyledon breaks through the prothallium, begins to elongate and soon becomes easily distinguishable from the stem.

THE ROOT.

As in the other members, the apical cell of the root is at first external, and it is not until at least one complete series of segments has been cut off from it that the first segment of the root-cap is cut off; so that we may fairly say that the first root is of exogenous origin, and in no sense adventitious. It does not differ in any particular in its method of division from that of Pilularia which the writer* has described at length, and will not therefore be further treated here. The root occupies by far the greater part of the hypobasal half of the embryo, and the foot is comparatively little developed, and does not show any definite succession in the cell division. While morphologically, perhaps, only the lower hypobasal quadrant is to be regarded as the foot, physiologically the whole lower surface of the embryo acts as such, and therefore in this sense, the foot must be said to owe its origin in part to the stem as well as to the root quadrants.

At first there is very little increase in the size of the embryo, the divisions being accompanied by very little growth (compare figures 15, 16 and 17). When growth does begin, however, it is very rapid, and within a few days the embryo breaks through the overlying prothallium cells, and the first cotyledon is then visible to the naked eye as a fine green point. The cotyledon is the first part of the embryo to break through the prothallium, but is quickly followed by the root, which bends down and soon penetrates the mud and fastens the young plant to the ground. During this rapid growth the contents of the large spore cavity are rapidly consumed, and serve to support the young embryo until it can lead an independent existence.

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*l. c. p. 253.

The embryo of Marsilia shows the closest resemblance to that of Pilularia, but also agrees closely with that of the Polypodiaceæ, with which we have also seen it agrees in the principal points of the development of the sexual organs.

THE SYSTEMATIC POSITION OF THE MARSILIACEÆ.

A comparison of the Marsiliaceæ with the other Pteridophytes will show at once such striking resemblances to the leptosporangiate ferns as to leave no room for doubting the close relationships of these groups. This is seen in the tissues and growth of the mature sporophyte. The leaf, stem and root, grow in the same way as in the Polypodiaceæ and the leaves also have the peculiar circinnate vernation of the ferns, which is absent in the Salviniaceæ. The structure of the fruit, too, upon which some stress has been laid is simply a peculiar modification of the leaf, developed as other parts of the plant have been, probably, in response to special conditions. The development of the sporangia, too, agrees in the principal details with the Polypodiaceæ, and the early divisions of the embryo correspond almost exactly with the embryo in that group. With the Salviniaceæ there is little in common, and botanists have long recognized this fact, although grouping them together for the sake of convenience, as both are obviously related to the homosporous leptosporangiate ferns.

We must bear in mind, however, that in the Marsiliaceæ we have to do with a very much specialized group, which has no immediate relations; and we should naturally expect to find this indicated in some way. Of the two genera, Pilularia comes nearer the Polypodiaceæ in several particulars. There are often two vegetative cells in the male prothallium, and the structure of the antheridium and spermatozoids departs less widely from the type found in that family. This is also true of the division of the sperm-cells into two distinct groups, not nearly so prominent in Pilularia, and merely indicated by the first division of the central cell of the antheridium in the Polypodiaceæ. So, too, the female prothallium is less reduced than in Marsilia, but in the latter its limits are already seen in the ungerminated spore.

The peculiar quadrifoliate leaf of Marsilia seems to be also a form not derived directly from the lower ferns. In Pilularia the leaf is perfectly simple, and this is the form of the first leaf in Marsilia; and it is not until several leaves have been developed that the characteristic four-parted leaf is met with.

Without going further into detail, we are pretty safe in assuming, as the writer has already done * that the Marsiliaceæ represent the end terms of a series of forms whose lower members are found among the leptosporangiate ferns, and probably the Polypodiaceæ; that of the two genera, Marsilia is the more specialized, and stands at the top, with Pilularia between it and and its homosporous relations; and we are not therefore to look for any connection with forms higher up, but conclude that this special line of development ends with Marsilia.

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*Campbell. The systematic position of the Rhizocarpeæ, Bull. of the Torrey Botanical Club, Oct. 1888.

EXPLANATION OF FIGURES.

PLATE III—THE MICROSPORE.

All figures magnified about 300 times, and all except figures 1 to 3 and 22 to 24, microtome sections.

Figure 1. Ripe fruit of *Marsilia vestita twice the natural size.*

Figure 2. A fruit which has been artificially opened and placed in water, x 1 ½. *x*, the valves of the fruit; *m*, the mucilaginous body to which the sori are attached.

Figure 3. A fresh microspore seen from the top.

Figure 4. Section of an ungerminated microspore; *n*, nucleus.

Figure 5. Section through the wall of a microspore x 600. 1, 2, 3, the three layers of the wall.

Figure 6. Surface views of the epispore; *a*, x 300, *b*, x 600.

Figure 7. Section of spore showing first signs of germination. The nucleus has moved to one side, and the granular protoplasm has collected in the middle.

Figure 8. Section of a spore in which the first division is completed; *x*, the vegetative cell.

Figure 9. A somewhat more advanced stage in longitudinal section; *m*, the basal cell of the antheridium.

Figure 10. Two longitudinal sections of a spore in which no basal cell was formed in the antheridium.

Figure 11. Cross section of young antheridium.

Figures 12 to 16. Successive stages in the development of the antheridium seen in longitudinal sections. *x*, the vegetative cell of the prothallium; *p*, the peripheral cell of the antheridium; *d*, the cover cell of the antheridium.

Figures 17 to 19. Similar stages of the antheridium seen in cross section.

Figure 20. Full-grown male prothallium and antheridium; *a*, *b*, in longitudinal section *c*, cross section; *d*, side view of a group of sperm cells.

Figure 21. Two sperm cells from a prothallium eight hours old showing the beginning of the formation of the spermatozoids; x 600.

Figures 22 to 24. Free spermatozoids x 600. Figure 22, *a* the active spermatozoid; *b*, one which has come to rest and the body become extended; 23 and 24, two stages similar to that shown in 22 *b*, but with the cilia omitted.

PLATE IV—THE MACROSPORE.

All the figures drawn from microtome sections fixed with chromic acid and stained with alum-cochineal and Bismarck-brown. Unless otherwise stated magnified about 150 times.

Figure 1. *a*, longitudinal section of ungerminated macrospore, x 60, *n*, nucleus; *b*, portion of the wall x 300.

Figure 2. Upper part of spore contents from a spore which has lain for one hour in water.

Figure 3. Upper part of spore two hours old.

Figure 4. Nucleus of similar spore, x 300.

Figures 5 to 6. First divisions in the prothallium; in 5 this has taken place in the ordinary way; in 6, the first division wall is vertical instead of horizontal.

Figure 7. Cross section of an older stage showing the first peripheral cell which is already divided.

Figures 8 and 9. Vertical sections of two young prothallia showing the peripheral cells, and in 9, the basal cells.

Figure 10. Two horizontal sections of a prothallium of about the same age as the one shown in figure 9.

Figures 11 to 13. Stages in the development of the archegonium in vertical section, *n*, neck; *c*, neck canal cell; *b*, ventral canal cell; *o*, the egg.

In figure 12 the prothallium is seen *in situ; k*, the nucleus of the spore.

Figure 14. A recently fertilized archegonium.

Figures 15, 16. Young embryos *in situ*.

Figure 17. Two cross sections of an embryo forty-two hours after the spores were placed in water.

Figure 18. Two longitudinal vertical sections of an older embryo; *l*, cotyledon; *r*, root; *st*., stem; *f*, foot. The apical cells are indicated by *x*, and the age of the first walls is indicated by the numbers I and II.

A NEW NOTODONTA.

BY H. H. BEHR.

Notodonta Pacifica.

Anterior wings: basal third brown bordered by a darker line, preceded by a dilution; from these the anterior half ashy gray, the interior half brown; the second line convergent and almost touching the first line that borders the basal third of the wing, preceded by a discal, linear mark, which is followed by a diluted shade, ending into a well darkened apical mark, divided by two nerves into three spots. Near the external margin a diluted fulvous shade.

Hind wings grayish.

Found in Placer County.

The species is similar to *N. Ziczac*, but the thorax is darker than the anterior wings.

Type in collection of the California Academy of Sciences.

ON LAND AND FRESH WATER MOLLUSCA OF LOWER CALIFORNIA. No. 2.

BY J. G. COOPER.

Since the publication of article No. I in these Proceedings, 2d Series, Vol. III, April, 1891, p. 99, another expedition, sent out by the Academy, has made large additions to our knowledge of the mollusca of the peninsula and gulf, a full account of which will need much time for preparation. As a beginning, I now give additional notes on those terrestrial species that are well known, leaving for future articles the notes and illustrations relating to new or undetermined species.

I may here refer to an article published by me in Zoe, Vol. III, p. 11, April, 1892, giving a full catalogue of the species then ascertained to inhabit the land and fresh waters between the United States boundary at Fort Yuma, on the Colorado River, to the Pacific and southward, of which the following is a summary:

TERRESTRIAL.		FRESH-WATER.	
Number known	32	Number known	12
Found north of boundary	14	Found north of boundary	10
Found also in Mexico	5	Found also in Mexico	4
Additions in Zoe list	10	Desert species	8
Additions now made	4	Brackish water species	8
		Additions in Zoe list	8
		Additions now made	6
Total terrestrial and fresh-water species			54

As a correction of that list, I must state that Mr. Hemphill informs me that he never found No. 36, *Veronicella olivacea*, on the peninsula, and its occurrence there is very doubtful.

The present collection was made chiefly by Mr. Gustav Eisen, whose department was the invertebrates, but many were also obtained by Mr. W. E. Bryant, especially marine species, on the islands of the gulf. As they did not usually go in company to the same places, different species were found by various collectors. The Academy is also indebted to Mr. L. Belding for many good living specimens obtained by him south of La Paz, in the rainy season, and therefore more perfect than usual.

I am glad to be able now to confirm the occurrence of two of the very rare species first found at Cape St. Lucas by Xantus (de Vesey), which have escaped collectors for thirty years since. The mystery of their scarcity is solved by finding that they belong to the highest regions north of the cape, in the Sierra Laguna, about latitude 23° 50′, which rise to 5,000 or 6,000 feet; thence they occur with less abundance downward, and especially on the east side, living on the north slope of the hills at various levels, and sometimes washed down, living or dead, to the sea-level.

Mr. Eisen's observations on the large species were very interesting, as indicating an imperfect distribution in zones, as follows:

	Feet		Feet
B. pallidior	100 to 500	B. proteus	2,000 to 3,500
B. inscendens	100 to 3,000	B. var. beldingi	3,000 to 5,000
B. sufflatus	2,000 to 3,000	B. artemisia	500 to 3,000

This distribution fully contradicts the theory that the two largest (named in upper line) could have been introduced from South America as food (though several species are sold in the markets of that country), as no evidence of their use in that way was seen. As to introduction with roots, Mr. Eisen thinks that *B. proteus* is too numerous on the mountains to have been imported, not occurring so plentifully in the more cultivated lower districts.

Bulimulus artemisia W. G. B. 1861. "Promontory of Cape St. Lucas, latitude 22° 52′, 1 exa.," *Xantus*. Two found on Sierra Laguna in the fig region, by Eisen, at 3,000 feet; they have one more whorl (9), and are almost ¼ inch longer than type. Both are worn, dead shells, but show faint vertical riblets on two nuclear whorls.

B. EXCELSUS Gould, 1853. Four, presented by Mr. Belding, are fine fresh shells, but one is bleached. The two upper whorls have fine riblets, as in *B. inscendens*, etc. Shells thicker than the other species, more shining, and outer lip more expanded than usual.

B. INSCENDENS W. G. B. 1861. Four living and 13 fresh, with 73 bleached shells, found near San José del Cabo by Eisen, do not show much of the variation forming var. *bryanti*, but he states that he found all on the ground, so that ascending trees is doubtless only done in the wet season, or not at all by some shells, thus accounting for the remarkable variations in form. Eleven from the Sierra Laguna above the "fig region," 3,000 feet, are larger, and have riblets on three apical whorls (not two as in others), the largest also with one more whorl (8). Nine of these have the divergent mouth. Six, dead, from San Leonicio, 3,000 feet altitude, have fine revolving striæ cutting the lines of growth, as in *B. proteus*, but less deeply; the mouth also nearly straight. On three presented by L. Belding, from between the cape and La Paz, this roughness is stronger, being as much so as in *B. proteus*. It is noticed as a light striation in Binney's description, but is now known to be quite variable in several other species. Mr. Eisen also got 83 other specimens from same mountains, above 3,000 to 4,000 feet altitude, which are usually more robust in form and shorter than the others, but many intermediate. I propose to call this extreme

Var. BELDINGI, as he sent the first specimen of this form in good condition from near San José del Cabo, Mr. Bryant also finding one at Punta Arena (near latitude

25° 30′, east coast). They differ from the usual forms in a short, oval shape, no divergence of mouth, and small size. The extreme of smallness is, length 1.10, breadth 0.50 inch. Those from the Sierra Laguna are a little larger, but intergrades occur up to the largest, which are 1.90 long and 0.70 wide. The average size of the species may be given as 1.25 long and 0.60 wide, or more robust than in Binney's figure. No clue to these variations is derived from altitude on the mountains, except that those fonnd highest are of a darker brown color. Large numbers were obtained living, when other species were inactive in the month of May.

B. PALLIDIOR Sowerby, 1833. Mr. Eisen obtained 97 shells near San José del Cabo, and Mr. Bryant 12 near Point Arena. They show all the forms between that figured by W. G. Binney as typical and Gould's *B. vegetus* (which was figured as a dark shell, but described as white). In size they vary from 1.80 inch long and 1 wide to 1.35 x 0.60. Mr. Eisen brought only one from the Sierra fig region, of middle size, and considered it almost entirely a lowland species. The specimen from the fig region has vertical riblets on the three upper whorls, and fewer of them are to be found on some of those from lowlands. This one also has rather light revolving striæ, as in *B. proteus*, suggesting hybridity. It was often found ascending trees.

B. PILULA W. G. Binney, 1861. Mr. Bryant alone obtained six specimens of this species, at Punta Arena, which are larger than Binney's types, looking more like a small variety of *B. sufflatus*, measuring 0.90 inch long, 0.60 wide. (Binney's figure is much smaller than the size he gives.) It differs, however, from the young of *B. sufflatus*, of same size, in having an open umbilicus. One specimen has faint traces of two bands on the body.

but is otherwise bleached. All of them have the vertical riblets on first two whorls.

B. PROTEUS Broderip, 1832. This species, as found on the peninsula, is not such a "protean" form as some others. Mr. Eisen sent 88 dead and mostly bleached shells from between the valleys and the "fig region" of Sierra Laguna, 3,500 feet altitude, and considers it a species almost confined to the mountains. They all have more or less rough sculpture, and no variation in the longitudinal darker stripes, but vary in form just as does *B. pallidior*. The largest from the fig region is 2.50 inch long and 1.20 wide. The smallest perfect one, found at "Laguna" by Mr. Belding, is 1.80 inch long and 1.20 wide. The only living one, also by Mr. Belding, is from "Painted Rock," and young; it has a thin epidermis of a pale brownish yellow color. The largest is a third longer than Binney's figure, the smallest about equal to it. In the young the three apical whorls are seen to have the same vertical riblets as in *B. inscendens*, etc. The only specimen giving a suspicion of hybridity between this and other species is the one of *B. pallidior* before mentioned, but the resemblance in form of small ones of this and some of *pallidior* is very close. As to other species, the rough sculpture sometimes occurs, but their forms are entirely dissimilar, thus making hybridity improbable.

B. SPIRIFER Gabb., 1867. Only one specimen, 1.45 inch long and 0.70 wide, of this form has yet been sent us, and this is a dead one picked up by Mr. T. S. Brandegee near La Paz, which is thus verified as its most southern limit. It agrees well with Gabb's figure in Amer. Jour. of Conch., but not so well with Binney's in L. and F. W. Shells. The prominent tooth winding inward from the columella is very marked in this, but not shown in Binney's figure. It is a specific character and nothing more, but is sometimes found even larger in thick callous-mouthed examples of *B. pallidior*, *B. inscendens*, and *B. proteus*, differing in form. As stated by Binney, the jaw has the characters of a very different family from *Bulimus*, so we may still include the shell among its externally similar neighbors. In this only, no trace of the vertical riblets is seen on the nuclear whorls, but they may be eroded.

B. SUFFLATUS Gould, 1853. Mr. Eisen sent 38 from Sierra Laguna, not different from type, the largest being 1.35 inch long and 1.10 wide. The young has a very thin yellowish epidermis, which peels off when adult, becoming pale brown. A specimen sent from La Paz by Mr. Belding has very narrow vertical brown stripes on three large whorls, 12 on the lower one, caused by epidermis being caught between some of the lines of growth, a not uncommon event, giving the same coloration seen in *B. proteus*. The upper two whorls, when not much worn, show the same riblets as in *B. inscendens*, etc. The many specimens of this and of *B. pilula* obtained do not settle the question as to their identity, as none of the latter contain the animal. In the specimens of both from near San José del Cabo, the young of *sufflatus* differ from *B. pilula* of the same size only in having the umbilicus quite closed; but both forms vary in this character, and the following variety certainly connects them:

Var. INSULARIS J. G. Cooper. Found only by Mr. Bryant on one point of Espiritu Santo Island, where he got six dead chalky specimens, apparently fossil, though only seen on top of the ground. Compared to Gould's type they are not so swollen (while others we have are much more so), but they closely resemble some from toward La Paz in form, being more narrowly ovate, but smaller. A half-grown one is as thin as many of them, closely resembling a large *B. pilula* from Point Arena, but the full-grown are thickened more than any of either form, the mouth of two having a heavy callous connecting the lips, and in one developing a blunt tooth on the inner wall. (This excessive thickening is also found in a var. of *Helix areolata* from the same island.) The umbilicus is like that of *B. sufflatus* of same size, and also as in large *B. pilula*. It is 1.20 inch long, 0.70 wide, mouth 0.65 long, 0.50 wide, in most thickened specimens; no distinct expansion of lip, but its margin is thickened. All these forms, which appear to be subspecies of one original species, have 5½ whorls, but specimens of the size of Binney's figure have but five (or even four, as he gives it, which is probably a proof of immaturity).

B. XANTUSI W. G. Binney, 1861. Of this Xantus only got four on the promontory. Mr. Bryant found 12 at the Rancho Lagunas, near Point Arena, not much above the level of the gulf. Mr. Eisen found 116 on the Sierra Laguna, mostly near La Chuparosa, 2,000 feet altitude, and all were dead, only 22 retaining any of the brown epidermis of living shells. The punctures given by Binney as the sculpture, are caused by erosion or imperfection of the shell, as they are entirely beneath the epidermis. The most perfect shell has narrow lines of dark and light brown alternating, as in *B. alternatus*, and some show these stripes in the shell also. The form varies from a short to a long oval, measuring 0.70 inch long and 0.50 wide to 0.85 long and 0.45 wide, which is the size of Binney's figure. I cannot detect any "minute revolving lines" on these specimens, and the "wavy striæ" are only on broken lines of growth. Adults have the outer lip slightly everted, and in one the vertical riblets usual to the group can be seen faintly in the epidermis of the two nuclear whorls (worn off in the others).

B. GABBI Crosse & Fischer, 1872. The description given by the authors of this name is very full, and shows that in size and form it is much like *B. xantusi*, having nearly the same dimensions as Binney's figure, viz.:

SHELL, MILLIMETERS.	APERTURE, MILLIMETERS.
B. gabbi.... .....20½ long, 11 wide	B. gabbi............11 long, 7 wide
B. xantusi........21 " 11 "	B. xantusi..........10 " 6 "

The chief differences are in color, described as "pale brownish flesh-color," and in sculpture, which, with the usual vertical riblets on the first 1½ whorls, has the rest strongly marked by longitudinal striæ crossing the lines of growth, "subgranulately impressed at the crossing," aperture a dull fleshy white, otherwise as in *B. xantusi*. Binney's mention of minute revolving lines in the types shows that, as in *B. inscendens*, it varies, and like that species may have them much stronger in local forms. *B. gabbi* was only referred to "Lower California," and is not mentioned in any of Gabb's own writings, but was no doubt described from fresh specimens collected by Gabb on the eastern side of the peninsula. As Binney described bleached specimens of *B. xantusi*, the resemblance was not very noticeable at the time. The authors call *B. gabbi* somewhat intermediate between *B. pallidior* and *B. proteus*, but the only way this can apply is in the sculpture being like that of the latter, which is sometimes found in *B. inscendens*, and may be expected in local varieties of others. As to possible hybrids of other species, see remarks under each. Whether these are really hybrids or only variations caused by local influences is a question not yet ripe for decision. I am inclined to consider *B. gabbi* the living and unworn state of *B. xantusi*, collected during the wet season, the latter being known only in a damaged state.

Columna ramentosa J. G. Cooper, 1891. *Rhodea californica* var. *ramentosa*, J. G. C. in Proc. Cal. Acad. Sci., Ser. 2, Vol. III, p. 102, 1891. Mr. Eisen obtained 15 specimens of the same shell found by Bryant, as described in the previous article, showing that to have been at the extreme lowest point of their range. Only five of them are entire, but most of them retain the fully-developed mouth. This shows that it has characters included under *Columna*, such as folds in the body-whorl, an oval mouth with everted lip, and complete spire. The characters of "Subgenus Rhodea," as quoted by Binney, exist in this shell only while immature, so that if *C. (Rhodea) californica* retains them permanently it must be a different species altogether.

C. ramentosa var. abbreviata J. G. C. A curious variation, from similar heights on Sierra Laguna, with the whorls reduced (from 13–15) to 8 or 9, and other differences. Five shells found, one with epidermis, but none alive. Has nearly the aspect of *Bulimulus artemisia*.

Unfortunately, none of these retain the soft parts. The shells will be figured in a future paper.

Another new form of *Cylindrellidæ* was found by Mr. Eisen, which will also be described.

Helix areolata Pfeiffer, 1845. Specimens of this and its varieties have been received in large numbers by the Academy, through many collectors and from the whole west coast between Margarita Bay and latitude 31°. They certainly do not show more extremes of variation between this, "*H. pandoræ*" and "*H. levis*" than occur in local forms of many others of our western species. A large number was, as usual, brought from Margarita Island, and, as usual, no other land-shells were found there, though very thorough search was not made. Its supposed limitation to the west coast was, however, modified by the discovery of a subfossil form on Espirito Santo Island, just north of La Paz, about latitude 24° 30′, by Mr. Bryant. He thinks it may still be found living there in the wet season, as well as the *Bulimulus* mentioned before.

H. AREOLATA var. EXANIMATA differs from the Margarita Island type in average smaller size and heavy thick shell, varying much in height and width, but all with six whorls. Mouth small, lips thick, sometimes connected by callus, some denticulate at base. Color white, or banded irregularly with three to ten bands of varying width, much faded, sometimes covering more than half the surface, and much less broken by light patches than in *areolata*. In some the whole spire is of a dark color, but they are all so chalky and fossilized that this may not have been so when living. (Thirty-eight specimens received.)

Diam., maj. 0.75 to 0.90 inch; min. 0.65–0.80; alt. 0.50–0.65.

HYALINA INDENTATA Say, 1822. Several of this species were found by Mr. Eisen high on the Sierra Laguna, and a few also in Sonora, Mexico, at an elevation of 3,000 feet or more.

They do not show the distinctive characters given for "*H. subrupicola*" Dall., and agree with Eastern specimens except in smaller size.

PUPA (VERTIGO) OVATA Say, 1822. Nine specimens of this species found with the last; rather small also. These two seem to be among the boreal American species which follow the mountain chains far south. Before traced south to latitude 31°, *Orcutt*.

SUCCINEA RUSTICANA Gould. This, which may be only a race of *S. oregonensis*, was found common by Mr. Eisen on the Sierra Laguna, near ponds, etc. The latter was already reported to occur south to latitude 31°, by Mr. Orcutt.

Limax. There is a species from the mountains which has not yet been identified.

Limnophysa humilis Say, 1822. Also common in the ponds of Sierra Laguna, at some height. Before known as far south as latitude 31° 51′.

Physa gabbi Tryon. Specimens from high on the mountains, where it is very abundant in streams.

Planorbis tumens Carpenter, 1857, and var. occidentalis J. G. C., 1870. Many specimens from a dry pond at San José del Cabo, sent by Eisen, prove the occurrence of this species nearly opposite Mazatlan, from whence it was first described, and also that it there attains the large size and five whorls described by me as found northward. The only difference from California specimens seen in them is their narrowness, which aids them in crawling through the dense water vegetation, and is, no doubt, a local variation caused by the density of aquatic vegetation in a tropical climate.

Planorbis subcrenatus Carpenter. A number of this species, brought by Mr. Bryant from some part of the west coast of the peninsula, prove on comparison to represent the other large west coast species. Their chief difference is seen in specimens of each of the same size showing one less whorl above in this, which also has the whorls rounder and the sculpture stronger.

Three other small species of this family, two differing subgenerically from any in the United States, remain to be worked up.

Pisidium (abditum) occidentale Newcomb. The only fresh-water bivalve from the peninsula, was found of all sizes, rather common in ponds on the Sierra Laguna, but showing no differences from the common shell northward.

ADDITIONS TO THE FLORA OF THE CAPE REGION OF BAJA CALIFORNIA.

BY T. S. BRANDEGEE.

The appended list contains names of such plants collected in the Cape Region of Baja California by the writer during the months of March and April, 1892, as are not found in the Flora of the Cape Region, Proc. Cal. Acad., Ser. 2, Vol. III. These plants were gathered during the dry season of a year following a rainy season of smaller rainfall than usual. The number of additions to the flora is not large, but the list has especial interest in the fact that it represents, in greater part, vegetation not to be found in flower at any other time of the year.

San José, the port of entry, was, as on previous trips, the place from which excursions were made. Miraflores, Agua Caliente, the Sierra de la Laguna and Sierra de San Francisquito were revisited, but the mountains were ascended by the Santiago trail, and many localities were examined for the first time; one of the most interesting of these was La Chuparosa (The Humming-bird). The trip made along the southern ocean-shore to Cabo San Lucas was of great interest, for several plants of more southern derivation — waifs from tropical lands — were found and collections were secured from the landing-places of the collectors of H. M. S. Sulphur, and the region about the locality where once stood the tent of Xantus. Afterward, nearly a month was spent at La Paz, during which time, however, but few additions to the known flora were made, for the region was much more dry and barren than usual; yet, a careful examination of the borders of the mangrove swamps and the saline flats was rewarded by the discovery of some Chenopods that, perhaps, were overlooked on previous occasions.

Mr. W. E. Bryant, who was one of my companions at this time, visited the islands San José and Espiritu Santo and made very complete collections of the plants then in flower and fruit, but no new name was added to the Cape Region flora, although much knowledge concerning distribution was gained.

The plants of the following list are numbered continuously from those of the previous one. Some corrections are made of mistakes in identification, and some notes that seem worthy of publication are inserted. The plants thus referred to are noted by their numbers, always less than 680, in the Flora of the Cape Region as well as by names.

680. Brassica nigra Boiss.—Sparingly introduced into gardens about San José del Cabo.

16. Lechea Skinneri Benth.—Mature specimens show that it is this species, and not *L. Drummondii* T. & G., that grows in the mountains.

34. Drymaria carinata Brandegee, was found with lilac-colored flowers.

32. * Drymaria crassifolia Benth. is perennial and *D. holosteoides* is annual. I have been unable to find any of the latter species in the Cape Region excepting about La Paz, and suspect there may have been some confusion of labels, and that the plants were collected at Magdalena Bay, where it is very common.

681. Malva borealis Wallm.—Introduced into the gardens of San José del Cabo and La Paz.

682. Sapindus Saponaria L.—A small tree maturing its fruit in April and May. Common about San José del Cabo and the region east of the mountains.

117. Lupinus Arizonicus Watson ? is common in

* Zoe, ii, 68.

sandy locations near the southern shore. It is generally an annual, but in some favorable situations persists and becomes perennial.

683. Trifolium microcephalum Pursh.—Abundant in the field of the Sierra de la Laguna.

127. Dalea trochilina.—Woody, 1–1½ m. high, branched above, glabrous: leaflets 7–15, obovate, 3–5 mm. long, thickly beset below with glands: spikes dense, 2–4 cm. long: bracts firm in texture, broad, narrowed to the base and somewhat abruptly lanceolate-pointed, white silky-pubescent, especially near their edges: calyx ribbed, white silky-pubescent, with deltoid lanceolate teeth shorter than the tube: corolla pink, conspicuous, the petals nearly equal in length, the banner round-deltoid in shape: stamens 10: ovary pubescent, 2–3-ovuled.

This species is common about La Chuparosa and peculiar to the summits of the high mountains of the Cape Region, where it is a conspicuous plant of the flora. It often becomes 3–4 feet high, and the ends of the branches bear an abundance of bright pink showy flowers. Its habit is to send up from the root a few, sometimes only two or three, woody stems that are naked below and much branched above; and as the stalks are only about half an inch in diameter, they are bent by the weight of the top. Herbarium specimens very much resemble *D. ramosissima* Benth., from Magdalena Island, but are easily distinguished by the very different and less deciduous bracts of the flowers, by the broader and less acuminate calyx teeth, and by the obovate and not cuneate leaves, inclined sometimes to be apiculate rather than retuse. *D. ramosissima*, with which this species was confounded in Proc. Cal. Acad., Ser. 2, Vol. III, 126, is a low woody plant, forming dense tufts hardly more than a foot in height.

129. Dalea Parryi T. & G.—A large form abundant about San José del Cabo.

132. TEPHROSIA PALMERI Watson.—During the month of October its flowers were ochroleucous, and in the same locality in March they were purple.

684. OLNEYA TESOTA Gray.—Buena Vista, La Paz, San José and Espiritu Santo Islands (W. E. Bryant): also, Guaymas, Hermosillo, Las Durasnillas to Arizona.

139. ASTRAGALUS NUTTALLIANUS DC.—A very abundant species in the mountains during the spring months, and persisting throughout the year about chip piles and in damp locations, apparently then becoming perennial.

685. ACACIA RŒMERIANA Scheele?—San José del Cabo and by W. E. Bryant from Espiritu Santo Island. The specimens seem to be the same as Pringle's 1739 of 1885 from Chihuahua.

190. ACACIA CONSTRICTA Benth.—Also found by Mr. Bryant on Espiritu Santo Island.

686. ACACIA CALIFORNICA.—A tree about 5–8 m. high, without spines, glabrous, the branches dark ash-colored: pinnæ a single pair on a pubescent rachis; leaflets two pairs, oblong or obovate, 15–30 mm. long, 20 mm. or less wide, obtuse or retuse, veiny, the terminal pair unsymmetrical: spikes 1 dm. or less long, densely clustered on the usually leafless branches, somewhat loosely flowered: flowers 4-merous: calyx pubescent, 1 mm. long, with obtuse lobes nearly half the length of the cream-colored corolla: ovary 8–10 ovuled; pod not seen.

This tree is very abundant in the region about La Palma and Miraflores. It blossoms in April, and at that time of the year its myriads of flowers are very conspicuous. The people call it "Guamuchlecillo," on account of its resemblance to "Guamuchle" (*Pithecolobium dulce*), and probably the pods do not produce the edible pulp of the *Pithecolobium*, so the termination "cillo" is added.

Only very immature pods could be found, but these are twisted and curved.

200. Albizzia occidentalis.—A small tree, 5–7 m. high, glabrous having usually a smooth, dark ash-colored bark: leaves 2 dm. long: pinnæ 4 pairs, the lower pair having each 3 pairs of leaflets, the next 4 pairs and the upper ones 5 pairs; leaflets obliquely oval, apiculate, very shortly pedicellate, 2–4 cm. long, the lower ones smallest and gradually increasing in size to the uppermost: flowers ochroleucous, capitate: calyx 3 mm. long, teeth short, deltoid: corolla 9 mm. in length, the lobes lanceolate, thickened at tip, half the length of the tube and unequal: stamens numerous, twice the length of the calyx and connected into an exserted tube: pod 1½–2 dm. long, 4 cm. wide, tapering at the base into a stipe 1 cm. long, pointed at the tip, straight, flat, thin-coriaceous in texture, margins through which the valves separate raised above the sides; seeds about 10, orbicular, flat, 1 cm. in diameter.

This tree is common in the Cape Region of Baja California, and is well known by the name "Palo Escopeta," and grows along the base of the mountains from Todos Santos on the west to San José on the south and Miraflores on the east. Its favorite habitat is the broad sandy wash at the mouths of large cañons, but it is not uncommon amongst the small trees throughout the region near the level of the sea. It was first collected by Xantus, who found no flowers; and Dr. Gray, uncertain as to its proper genus, referred it doubtfully to *Leucæna macrophylla*, with the remark: "From the pod and look of the foliage it may be an Albizzia." Señor Cypriano Dodero has obligingly sent me flowers from the trees growing along the plaza of San José, and from them its true botanical position has been determined. The flowers appear in June or July, and the large pods remain pendent on the tree the entire year, their size and abundance making it a conspicuous one of this region. Through the kindness of Dr. J. N. Rose I have been able to see specimens of a tree collected by Dr. Palmer at Manzanillo that may be the same as the Cape Region plant, but flowers were not collected, and in consequence there is not absolute certainty in the identification.

The genus Albizzia has been supposed to be confined to the warm regions of Asia, Africa and Australia, so that an indigenous species in Mexico was not to be expected.

687. RHUS TOXICODENDRON L.?—Growing in the manner of variety *radicans*, but the color and appearance of the leaves are peculiar. Only a few immature flowers were found. Summits of the mountains.

688. PITHECOLOBIUM MEXICANUM Rose.—"Palo Chino." The wood is used for making tables and chairs. La Palma, Agua Caliente.

689. CONOCARPUS ERECTA Jacq.—Grows along the southern shore.

690. LYTHRUM ALATUM Pursh.—Sierra de San Francisquito and along the Rio San José.

691. OPUNTIA PROLIFERA Engelm.—The fruit produces quantities of seed, but the general appearance of the plants is the same as when growing about San Diego.

246. CEREUS.—An undetermined species that bears light-scarlet flowers.

249. CEREUS THURBERI Engelm.—Along the coast between San José and Cabo San Lucas a form of this species grows that is smaller and has a darker appearance than usual. The people of the region insist that it is a different species, that the fruit opens in a different manner, is smaller and has a different flavor; but there seems to be no difference in the spines and flowers.

692. Eryngium nasturtiifolium Juss.—San José del Cabo. The species was determined by Mr. Rose.

693. Sambucus Mexicana Presl.—Not uncommon about deserted dwellings where it had been introduced for its supposed medicinal properties.

694. Diodia crassifolia Benth.—On sand-hills near the southern shore.

695. Pluchea odorata Cass.—San José del Cabo. Growing about irrigation ditches.

297. Baccharis Bigelovii Gray.—Differing from specimens of this species in having broader and sometimes more oval leaves.

696. Gnaphalium Sprengelii Nutt.— Damp locations along the San José river.

697. Rumfordia connata Brandegee, Zoe, iii, 241, pl. xxiii. Summits of the high mountains.

325. Perityle crassifolia Brandegee, is perennial, and not annual as described. I collected specimens in 1892 from the same plants that furnished the original ones two years before.

338. Leptosyne dissecta (Benth.)—I have been unable to find this plant in any of the localities of the Cape Region visited by H. M. S. Sulphur, and suspect there has been a confusion of labels and that, as in the case of *Drymaria holosteoides*, the specimens came from Magdalena Island.

698. Sonchus oleraceus L.—San José del Cabo, La Paz. A weed sparingly introduced into cultivated grounds.

699. Centunculus minimus L.—San José del Cabo, about pools of standing water and in the Sierra de San Francisquito near springs.

700. Samolus ebracteatus HBK.—San José del Cabo. Growing along streams and ditches.

701. FORESTIERA PORULOSA Poir. — San José del Cabo.

702. ASCLEPIAS ALBICANS Watson.—La Paz.

703. ERYTHRÆA NUDICAULIS Engelm.—High mountains of the interior.

704. ERYTHRÆA DOUGLASII Gray.—The petals are minutely dentate, as also are those from Alta California.

371. GILIA NUTTALLII Gray.—There are only two ovules in each cell, otherwise it seems to be *G. floribunda* Gray.

705. BUMELIA LYCIOIDES Pers. ?—A thorny bush growing at 4,000 feet elevation in the mountains.

706. TOURNEFORTIA sp.— Differing from *T. Hartwegiana* Steud. mainly in the shape of the corolla. San José del Cabo.

707. PHACELIA SCARIOSA Brandegee.—La Paz.

708. NAMA DEMISSUM Gray.—La Paz, San José del Cabo.

709. CRESSA CRETICA L.—La Paz.

710. SOLANUM NIGRUM L.—San José del Cabo.

711. NICOTIANA CLEVELANDI Gray.—La Paz.

712. GALVESIA JUNCEA (Benth.)—On the rocks of Cabo San Lucas a form of this species occurs with nearly orbicular leaves often longer than the internodes, and the whole plant is rather densely glandular-pubescent. The filaments and ovary are less pubescent than in the type, but otherwise the flowers scarcely differ, and some plants even at this locality approach the type much nearer.

713. MIMULUS FLORIBUNDUS Dougl.—San José del Cabo.

714. SIBTHORPIA PICHINCHENSIS HBK. — Growing on damp moss-covered rocks in the high mountains at La Chuparosa.

715. Aphyllon sp.—Dried stalks of a species that is probably *A. Cooperi* Gray, from the Sierra de la Laguna.

456. Dianthera incerta.—Perennial, suffruticose, tufted, 1–2 dm. high, hirsute-pubescent; stems channeled: leaves ovate-lanceolate, entire, sessile or very shortly-petioled, somewhat cordate: flowers usually 2 in the leafy axils: bractlets narrowly-lanceolate, shorter than the calyx: calyx 4 mm. long, cleft ¾ its length into four linear-lanceolate segments: corolla purplish, 10–15 mm. long, the linear tube longer than the nearly equally 4-lobed limb; upper lip entire, somewhat galeate, lower lip deeply 3-parted, saccate-protuberant in the throat: stamens inserted in the throat, much shorter than the corolla-lobes: anthers nearly equal but oblique, both mucronulate at base and the upper one at apex: style pubescent below, sterile base of capsule one-third its length; retinacula obtuse; seeds glabrous, rugose.

The species is somewhat intermediate between Siphonoglossa and Dianthera, having the mucronulate anthers of the former and the oblique connective belonging to the latter. San Bartolomé and slopes of the mountains above Agua Caliente.

716. Bignonia sp.—Climbing to the top of the Acacias. Leaves bifoliate, with no prolongation of the petiole; fruit a foot or more long. It was long past flowering. Miraflores.

717. Hyptis sp.—A bush with curving branches and a long densely-flowered terminal thyrsus. San José del Cabo.

718. Plantago Patagonica Jacq.—Sierra de la Laguna.

719. Polygonum acre HBK. — San José del Cabo and in the mountains.

720. Parietaria debilis Forster.—San José del Cabo.

721. Salicornia ambigua Michx.—Saline soil about La Paz.

722. Suæda suffrutescens Watson.—La Paz.

723. Chenopodium murale L.—San José del Cabo.

724. Atriplex Barclayana (Benth.)—San José del Cabo.

725. Batis maritima L.—Cabo San Lucas and La Paz.

726. Iresine celosioides L.—San José del Cabo.

727. Quercus sp.—La Chuparosa.

728. Agave sp.—Cabo San Lucas.

729. Agave sp.—La Paz.

730. Juncus xiphioides Meyer.—Sierra de San Francisquito.

731. Eleocharis arenicola Torr.—San José del Cabo.

732. Carex sp.—Sierra de la Laguna.

733. Carex sp.—Sierra de la Laguna.

734. Tripsacum Lemmoni Vasey.—High mountains.

735. Festuca tenella Willd.—La Chuparosa.

736. Gymnogramme triangularis Kaulf.—Not uncommon in the high mountains.

737. Pteris aquilina L.—Sierra de la Laguna. Not common.

738. Asplenium monanthemum L.—La Chuparosa.

739. Equisetum sp.—Old sterile specimens. La Chuparosa.

ANATOMICAL STUDIES ON NEW SPECIES OF OCNERODRILUS.

BY GUSTAV EISEN.

The genus Ocnerodrilus appears to be confined to the American continent, where it has a large geographical distribution, at least through the more temperate or tropical regions. The expedition sent out by the California Academy of Sciences to Baja California and Mexico brought home quite a number of earth and water Oligochæta, among others numerous specimens of at least two new species of Ocnerodrilus, for which I here propose the names of *Ocnerodrilus Beddardi*, and *sonoræ*. Other species were found by me in Central America several years ago. New specimens of *Ocnerodrilus occidentalis* have also come to hand from the old and only locality where it has been found to date, and I am able to add some points to our previous knowledge of this worm. Besides these species, another one has lately been described by Beddard, from British Guiana, which in one or two important points differs from those examined by me. Thus there are known in all ten species of Ocnerodrilus, all tropical or semi-tropical in their habits. The systematic position of this genus is a most interesting one, as showing affinities with both the water and with the land Oligochæta, with a closer relationship with the latter. Among these the new genus Gordiodrilus (Beddard) shows the most affinities with our worms. The additional species of Ocnerodrilus which I here describe will necessitate a change in the genus characteristics as lately formulated by Beddard, but will also further verify his remark that both Ocnerodrilus and Gordiodrilus are characterized principally by negative characters.

As regards the characteristics used to define the species a few words may suffice. The genus appears naturally divisible in two distinct groups, one in which the lower part of the sperm ducts (efferent ducts) is enlarged and shuttle-like, and one in which the duct throughout is of even width. The form and size of the spermatheca varies some, but within certain limits it appears constant. They are of the greatest value as species characteristics, especially so the presence or absence of rudimentary diverticula. The lower part of the prostate appears very constant as regards form and relative size. In some species the muscular differentiation has progressed considerably, in others it has hardly begun. It is interesting to note that the three species which belong to the latter class, also show other common characteristics, which bind them together in one group. The relative size and lobation of the septal glands, especially the one in somite v, is of the greatest importance in determining the species, and may be used to the best advantage. The relative size and form of the sperm-sacs, especially those in somite ix and xii, are constant within certain limits, and are species characteristics of no mean value. The relative thickness of the anterior septa is also constant and should be noted. As regards testes, ovary and oviducts, I have not been able to note any great or constant differences. They appear all very much alike, and are all constant in their location. The presence or absence of the setæ in the inner couple of somite xvii may also be used in determining the species. In some species both setæ are absent, in others only one is wanting, and there appears to be a constancy as regards which one of the setæ in the couple. In one species both setæ are present. The clitellum varies to some small extent. It is much shorter in some species than in others, and may in such cases be used as an exterior characteristic. The interior characteristics are the best and surest. In the present state of our knowledge it can hardly be said that the exterior characteristics are of sufficient prominence to be used for determining the species, except when coupled with interior ones. To the already accustomed eye, almost every species shows certain peculiarities in shape, size and color, that may be useful in assorting the worms, but these peculiarities are not such as may be intelligently described and easily understood.

Ocnerodrilus Beddardi n. sp. Figs. 1, 14, 17, 18, 19, 20, 27, 28, 29, 30, 32, 37, 40, 49, 55, 56, 74.

External characters. The worm varies in length from one and a half to two inches when fully extended. My method to measure these and similar worms is to first kill them in very weak alcohol, a few drops being added to the water from time to time. When the worm is dead, it should be at once taken out of the weak alcohol, straightened out and then placed in a narrow glass tube with strong alcohol. In this manner the undue contraction and bending of the worm is prevented, and the medium contracted length may be measured. *Ocnerodrilus Beddardi* and *O. agricola* are the two longest species of the genus known so far. While their length is nearly double that of the smallest species, *O. occidentalis*, the width of the body is hardly wider than that species. Compared to this form *O. Beddardi* is more tapering towards both head and tail.

The *clitellum* extends from somite xiv to somite xix, encroaching on xiii, and sometimes not quite covering somite xix. It is very much thickened above and on the side, but in the immediate vicinity of the ventral ganglion it entirely disappears. The spermathecal pores, one pair, are in somite xix. The ovipore, one pair, in xiv. The male pores are in somite xvii. The nephridio-pores open in front of all the ventral setæ. Seen from the exterior the posterior nephridia appear like heavy white masses, entirely filling the somites. The setæ resemble those of the other species of the genus, are not sculptured or bifid. They are present in all the somites except the first. In the inner couple of somite xvii the inner seta is wanting, there being only one seta in the immediate vicinity of the male pore. All the setæ are of equal size and form and distance from each other in each couple. The prostomium is well developed and narrower than in *O. occidentalis*, but of similar form as in most of the other species.

Septa. The septa separating the somites begin between somites iv and v, and continue from there on to the posterior end of the body. In the segments of the clitellum they are much reduced. The septum between iv and v is very thin, the following four septa separating somites v–ix are much thickened, and thicker than those in any of the posterior somites. They increase in size posteriorly in such a way that the septum between somites viii and ix is the thickest of the four, although this septum supports only a very small septal gland. The succeeding four septa are much thinner and about equal to the one between somites iv and v, but thicker than those situated behind the clitellum. The septa between somites v–viii posteriorly, are sparsely covered with small glandulous cells, especially in the region of the œsophagus. A quantity of perigastric cells are seen floating around in all the somites. These cells are round, with granulated contents (fig. 9).

Septal glands (fig. 1, *s. gl.*, 45). Somites v–viii contain septal glands, which in the first four somites (v–

vii), are very large, filling the greater part of the cavity. The gland in somite viii is so much reduced in height that it is readily hidden in the folds of the septum. The anterior gland in somite v is much higher (fig. 45) than the other glands, and extended in the direction of the pharynx which it reaches and (when the worm is contracted) apparently partly overlaps.

The septal glands in somites vi, vii and viii are attached to the septum and the œsophagus. From this central base the gland extends in all directions, completely surrounding the œsophagus, while numerous muscular bands connect it with the body-wall of the next posterior somite. In a transversal section the gland is seen to be a composite one consisting of four or more lobes or parts (fig. 22, *O. occidentalis*), which are connected at œsophagus, but at their outer extremities are free. Each part is grouped around a muscular band, which passes through the gland and at the free apex of the gland passes into another muscular band which takes its origin on the surface of gland. Both pass then as one muscle through the posterior septum and connect with the parietes of the posterior somite.

The muscles of the two larger glands in somite v pass through a whole posterior somite and two septa before connecting with the body-wall. The upper, centrally located, glands in somite v differ from the other glands by being grouped around a pair of muscular bands which head on the pharynx and transversing the glands, penetrate the posterior septum and somite in a way similar to what takes place in the other glands. The effect of this arrangement is such as to cause the posterior glands to be flattened out against the septum, while the anterior gland is stretched out towards the pharynx in the opposite direction (fig. 45). This movement is constantly taking place in the live worm. With every pulsating movement of the vascular system, the septal glands participate, being pulled backwards and forwards and side ways. In longitudinal sections of the worm, the gland in somite v appears as if almost connected with the salivary glands surrounding the pharynx, part of the latter being arranged around the same muscular band (fig. 2, *s. gl. m.*). All these septal glands are attached to the œsophagus and probably empty into it. The contents of the septal gland cells consist of dark irregular sphæroid bodies, almost completely hiding the nuclei and the cell-walls (fig. 6).

Alimentary canal (fig. 1 and 2). There are a buccal region, a pharynx, œsophagus, a tubular region and a sacculated intestine. Gizzard and typhlosole are wanting. The buccal region has very thin walls and is as usual reversible. Posteriorly it connects with the pharynx which is very large and muscular and ends in the end of somite ii. The pharnyx is exceedingly muscular, but developed only on the upper side above the œsophagus. A section through a contracted worm shows the pharynx folded back on itself forming a set of three sinuses of which the middle one is the longest (fig. 2), and the two others of varying length according to the exact region through which the section is made.

This muscular pharynx is supported by a large number of muscular bands, which connect the pharynx with the parietes of the somites iii–vii. The anterior ends of these muscular bands are arranged in three circular rows corresponding to the septal lines, the septa themselves here being wanting. In every such row there are from 3 to 4 pairs of muscular bands. In a longitudinal section one each of these bands comes in view, making 3 appear as upper and 3 as lower ones, while a fourth one connects the anterior end of the pharynx with the body-wall of somite iv. Two more muscular bands run centrally backwards, around them being grouped the upper septal glands in somite v (fig. 2, *s. gl.*). At the place of attachment to the pharynx these muscular bands are straight and less separable in distinct bands, directly becoming more contractile and wavy before emerging from the pharyngeal region. These muscular bands are partly covered with large salivary glands (fig. 2, *sl. gl.*).

Salivary Glands. While yet in the pharyngeal region the pharyngeal muscles are covered with large salivary glands, in many respects similar to the septal glands already described. The salivary glands are situated in somites iii and iv and partially in ii. They form apparently one connected mass, exteriorly and posteriorly differentiated into a number of broad and narrow lobes, some of which appear to be constant in shape and position, or at least vary but little. On the upper surface of this pharyngeal mass there are thus seen two long narrow glands (fig. 2, *sl. gl.*), one on each side of the median line, and running backwards through somites v, vi and vii. The lobes of the other more lateral salivary glands are broader and more or less multi-lobed. This part may again be distinguished as one lateral and one inferior part, the latter one being the smallest, and, as regards its position, almost resting on the upper part of the œsophagus. Towards the muscular pharynx all these glands diminish in thickness, and in the immediate vicinity of the pharynx proper they are entirely crowded out by the muscular bands which closely cover the pharyngeal surface. On the uppermost part of the pharynx, under the cerebral ganglion, and in front of it another group of salivary glands is seen, but of diminished size. The whole mass of glands and muscles project considerably beyond the point of the beginning of the œsophagus in somite ii. A beautiful vascular network is interspersed between the muscles and in the glandular mass, originating principally from the lateral vascular trunks coming from the diverticula of the œsophagus. Only with a very strong staining of eosine do these minute vessels become clearly visible (fig. 2, *v.*).

The *œsophagus* consists of a long, comparatively narrow cylindrical duct, beginning at the boundary between somites i and ii, and extending to the diverticula in somite ix. Its inner epithelial walls are much folded. Exteriorly the œsophagus is of even width, neither contracted nor swollen at the septa nor at the place where the diverticula enter it. In *Ocnerodrilus Eiseni*, lately described by Beddard, the œsophagus appear to be considerably enlarged at the junction with the diverticula. In *Ocnerodrilus Rosæ* the swelling is somewhat less, but in other species it is almost entirely wanting. If this character is constant, or if it changes according to the contractions of the worm, remains yet to be seen.

Diverticula of œsophagus. In somite ix the œsophagus is furnished with one pair of diverticula, or pouches resembling the calciferous glands in other genera. These diverticula are found in all the species of the genus, they vary a little in form, and are of various lengths, according to the state of contraction, and are hardly constant enough to be used as species characteristics, although in different species a difference in form may be noticeable.

The pouch in Gordiodrilus which is median and single, differs considerably from the corresponding, but paired, organ in Ocnerodrilus. In the former genus the blood vessels traversing the pouch form a network, or at least anastomose with each other, which is not the case in Ocnerodrilus. In the various species of the genus the pouch is of the same general structure, and as far as I can see varies only slightly as to form and number of parellel blood vessels. The description given here of the pouch in *Ocnerodrilus Beddardi* may therefore in a general way be applied to those of the other species too, Ocnerodrilus occidentalis has of all species the simplest diverticala furnished with the least number of blood vessels.

The pouch contains only one single room, widest at the middle, or near the middle, and tapering towards both ends, but especially so towards the distal end. But this interior cavity of the pouch does not exactly correspond in form to the exterior form of the organ, which tapers more towards the distal end than the inner cavity does (fig. 12). The wall of the pouch is traversed longitudinally by a number of ridges consisting of blood vessels, which lie close enough to almost touch each other, but which do not anastomose (fig. 20). They collect in the distal end (fig. 20, *c. l. v.)* and emerge as one single vessel *(c. l. v.)*, the lateral vascular blood vessel which longitudinally traverses the body (fig. 1, *l. v)* from the pouch towards the prostomium and somite i. The distal end of the pouch is directed forward and downward, resting heavily on the anterior septum between somites viii and ix, pressing the septum forward. The longitudinal blood vessels originate from a single stout blood vessel in the tubular intestines. This vessel does not appear to emanate directly from the dorsal vessel above it, as I have not been able to see a direct connection, but it comes apparently from a very short sub-dorsal vessel which connects the two hearts in somites x and xi, and which is partially or entirely covered by the intestine. This vessel, first described by Beddard, does not exist in all species, but owing to its fragility it is difficult to determine its presence except in live specimens.

The main vessel in the pouch (fig. 20, *a. v.)* branches in several parts close to the entrance of the pouch, the various vessels running longitudinally and parallel to the distal end. These vessels group themselves into about six bunches (fig. 20), and throughout the greater length of the pouch the vessels of each branch keep together, forming elevated, longitudinal and parallel ridges, which encroach on the upper but especially on the inner surface of the pouch. On the inner surface these ridges are prominent and sometimes so large as to almost divide the pouch in several parallel chambers. No such division takes place, however, the inner large cavity being only one. At the distal end these ridges come together, and the inner cavity ends between them in various narrow sinuses, one each between two ridges (figs. 19 and 12). These sinuses continue forward and again unite with an inner system of lacunary cavities (fig. 12, *i. l.)* very much as is the case in the pouch of Gordiodrilus, as described by Beddard. In that genus these cavities connect with the nephridium through a narrow tube. In none of the sections I made of Ocnerodrilus could I find with certainty a similar arrangement, but I am strongly inclined to believe that one really exists, as close to the concave side of the outer wall of the pouch I frequently found a comparatively broad tube with a clear and large, glandulous lumen which seemed to end on the outside of the pouch near its distal end, just opposite to where the inner cavities begin. A possible connection with the nephridium I could not establish. The inner lining of the pouch is ciliated and very thin. It is strongly striated, consisting of flattened cells with round nuclei. This striation is also seen in the lining of the inter-lacunary cavities, but not in the inter-vascular tissues in which the blood vessels are imbedded. The nuclei are of the same form in the lining epithelium as in the inter-vascular cell tissue. As in Gordiodrilus, the nuclei are less in number than the cells and of unusually large size for so narrow cells. At the entrance of the narrow part connecting the pouch with the tubular intestine the epithelial lining is thicker than in the main cavity of the pouch. In one specimen the left pouch was forked and a lateral vascular trunk issued from each pouch, but on account of the nature of the section I could not follow its course forward.

The pouch is supported by a heavy muscular band which attaches to the center of the convex or outer part of the pouch and thence runs through the posterior septum connecting with the parietes of somite x.

The position of the pouch on somite ix appears entirely constant, none of the 10 species known differing in this respect. With the pulsating of the bloodvessels the pouch expands or contracts following the same beat as the hearts. In alcoholic specimens the pouch may be more or less contracted in the same species. There is no gizzard and no typhlosole.

The tubular intestine which extends from the pouch in somite ix to the sacculated intestine in the xii resembles (fig. 19), greatly the œsophagus in form. It is tubular, neither wider nor narrower and its inner epithelial lining is strongly ciliated. At the junction with the sacculated intestine it is sometimes slightly contracted, but there is no real narrowing of the tube as indicated in Beddard's figure of *Ocnerodrilus Eiseni*, nor is there any swelling at the junction of the diverticula as in that species. The vessel furnishing the blood for the diverticula first enters the tubular intestine from the hearts.

In *O. Rosæ* the œsophagus and tubular intestine are much nipped by the septa and enlarged at the diverticulum entrance, more so than in most other species, but not to the extent that it is figured by Beddard in the species described by him. The narrowing or swelling may be to some extent the result of contraction, but it appears at least to be partially a character of the species, as some species do not show it, even in a series of specimens.

The sacculated intestine commences with somite xii (fig. 1, *s. i.*). It is wider in this somite than anywhere else. In the following clitellial somites the swellings are are smaller and in those posterior to somite xix it has reached its normal form, only gradually diminishing towards the caudal end (fig. 1). The muscles supporting the sacculated intestine and connecting it with the parietes start half way between the septa. Upon the strength and size of these muscles depend the greater or smaller sacculation of the intestine.

Vascular System. There are two primary longitudinal vessels, extending from one end of the body to the other. The dorsal pulsating vessel and the ventral non-pulsating vessel (fig. 1, *d. v.* and *v. v.*). These vessels are connected in the usual way in somite ii, and in the posterior somite, forming respectively the pharyngeal and caudal commissure.

In somites x and xi these two vessels are also connected by secondary vessels, forming one pair of hearts in each of the above somites. These hearts are the most prominent features of the vascular system, whether the worm is alive or cut up in sections. The two pairs are alike. Emanating in the posterior part of the somite, they form large sack-like vessels, especially wide and sack-like close to the dorsal vessel, and tapering downwards to the junction with the ventral vessel. These hearts are strongly pulsating, expanding and contracting in harmony with the dorsal vessel and the vessels of the pouch.

In somites x and xi these hearts are connected by a sub-dorsal vessel, which enters the tubular intestine probably in somite xi, and in somite ix passes directly into the diverticulum of the tubular intestine.

Except through these four hearts the two vascular trunks do not directly connect in the central somites. The ventral vessel emits one pair of secondary non-connecting vessels in each somite. A corresponding non-connecting vessel (figs. 1 and 30) is also emitted by the dorsal vessel in all the somites except ix, x and xi. In the latter two somites they are replaced by hearts. This secondary dorsal vessel is emitted in the posterior portion of the somite, close to the septum. It runs at once straight out through the body cavity, in almost right angles with the dorsal vessel, until it strikes the body wall, where it branches and forms a dermal system, especially developed in the inferior part of the body, sending out ramifications which extend along the longitudinal muscular layer below the neural ganglion, but which do not connect or form any sub-neural longitudinal system (fig. 30), all the vessels being strictly transversal. In somites x and xi these transversal vessels have been replaced by the hearts. In somite ix one pair of lateral blood vessels pass from the sub-dorsal vessel and the hearts through the diverticula forming the lateral trunks (fig. 1, *lv.*), which extend forward on either side of the worm to the peristomic region. In each of somites v to viii, each one of these trunks sends out one secondary vessel, which enters the septal glands in the somite (figs. 1 and 2), and one vessel which supplies the dermal and sub-dermal parts of the somite. The main lateral trunk is branched in somite v or vi, one branch going forward and upward, supplying the prostomic and peristomic regions, while the other branch furnishes the pharyngeal glands and muscles with the necessary blood. In the anterior somites these trunks branch repeatedly, forming in somite i and in the anterior part of somite ii a perfect network of capillary blood-vessels, which connect with the capillaries from the dorsal and ventral vessels, both above and below the pharynx and œsophagus. The vessel supplying the œsophageal diverticulum branches in the organ into numerous parallel vessels, which again collect into one trunk, as has been already mentioned. There are no dark epithelial pigment cells on any of the vessels, but the muscular part of the dorsal vessel and of the hearts is thick.

The ventral main longitudinal vessel emits one secondary vessel in each somite (fig. 30, *l. v. v.*). This vessel starts out anteriorly to the dorsal secondary vessel (fig. 30, *l. d. v.*), and is parallel to the latter. It branches as soon as it reaches the body-wall into two distinct trunks, one smaller descending, and one larger ascending. The former one is very short, and extends, with branches, below the neural-ganglion, but does not anastomose with the vessels from the dorsal branch. The ascending branch again divides in two parallel branches, which closely follow the parietes and again branch, forming a wide meshed capillary network on the dorsal side of the body-wall. This secondary ventral vessel is present in all the somites, even in ix, x and xi. The secondary branches of the dorsal and vental vessels are of about equal length and thickness, but the branch from the ventral vessel is much more branched than the dorsal secondary vessel, which is almost entire, and even in the ventral region emits few branches. A similar arrangement is found in Sparganophilus, lately described by Benham. (Quart. Journal Micr, Sc., Nov., 1892.)

These secondary vessels are similar in the various species, except in *Ocnerodrilus limicola* and *Hendriei*, in which species the dorsal secondary vessel in somite ix is transformed to a connecting vessel between the ventral and dorsal vessel, similar to a heart (figs. 31 and 38, *c. vl.*) but of less thickness and more cylindrical throughout its length. A gastric secondary vessel supplies the sacculated intestine. It leaves the dorsal vessel anteriorly to the other branches almost in the center of the somite, or half-way between the septa. It develops into a large gastric system, especially prominent in the somites of the clitellum.

There are no blood-vessels on the nephridia.

The septal glands are furnished liberally with blood-vessels, emanating in each somite from the lateral vascular trunks (fig. 1, *v.*). As will be seen, the vascular system in Ocnerodrilus resembles greatly that of Gordiodrilus, especially in having the dorsal and ventral vessels only connected in somites x and xi (or in ix, x and xi).

Nephridia. The nephridia are present in all the somites, commencing with somite iv. The anterior four nephridia are very small, degenerate, devoid of or with very few peritoneal cells. The nephridium in somite iv is the smallest, the one in the vi is larger and the one in somite viii the largest of all the anterior nephridia. The nephridium in somite ix is always very large and furnished with copious masses of peritoneal cells. This may possibly be in some way dependent upon the supposed connection between this nephridium and the diverticulum in this somite.

The nephridia in somites x and xi are smaller, somewhat degenerate, but not to the extent as described by Beddard in *O. Eiseni*, but still covered with peritoneal cells which stain differently from the surrounding sperm-sacs. The nephridia posterior to somite xii are all covered with peritoneal cells. They rather increase in size towards the caudal end, the largest nephridia being found a comparatively short distance from the tail end (figs. 5, 10, 14). The size and quality of these peritoneal cells vary considerably in different specimens; sometimes they are perfectly transparent with no dark cell contents, at other times they are so filled with a granulated mass or sections that the nuclei are not visible. Quite frequently the anterior nephridia show some peritoneal cells, the anterior ones always less than those in somite viii which nearly always possesses a few of them. As has been already stated the nephridia in somite ix show a large mass of peritoneal opaque cells as many as any of the largest nephridia behind the clitellum. This is not the case in all species. For instance, in *Ocnerodrilus Rosæ* the nephridium in somite ix is entirely destitute of peritoneal cells. Still this nephridium is larger than any of the nephridia anterior to the clitellum (fig. 23, *n. ph.*).

The upper part of each nephridium contains the greatest quantity of peritoneal cells. In the middle part the number diminishes, again increasing in the part nearest the nephridio pore. These pores open between the setæ and the anterior septum in line with the inner row of setæ. In the lower part of the nephridium the peritoneal cells cover the canal on one side, while in the upper part the canal is entirely hidden by the cells. From the outside the nephridia appear like very large whitish masses almost entirely filling the somites. The quantity of peritoneal cells vary in different species. In some, as in *Ocnerodrilus occidentalis*, the peritoneal cells even in the posterior nephridia are comparatively few.

Testes. There are two pair of testes, one in somite x and one in xi. This being the rule in most species. They are attached to the ventral side of the anterior septum against which they are generally pressed flat.

The testes in somite x are much more lobed than those in somite xi the latter being entire or heart-shaped while the former are multi-lobed.

While this appears to be rather constant, I do not think any great specific value should be placed on the shape of the testes, the lobes varying in form and number (fig. 3 and 4).

Sperm-sacs (fig. 1, *ssl.* and *ss.).* There are two constant and two pairs of variable sperm-sacs. The constant sperm-sacs are found in somites ix and xii; the variable ones in x and xi. These latter sperm-sacs vary much as regards their size. All the sacs are situated principally in the upper part of the body. The sperm-sacs in somites x and xi are connected, but those in ix and xii appear entirely isolated, neither connected with the other sacs or with each other.

The sperm-sac in somite ix, consists of a heavy globular mass attached to the posterior septum, between somites ix and x above the œsophagus. It is lobed, there being at least four or six large lobes and several smaller ones. It is connected by very narrow tubes following the septum, with the testes in somite x. The sperm-sac in somite xii is of a different and very characteristic shape. It is much lobed and covers the upper and front part of the sacculated intestine in this somite like a well-fitting collar. It is attached to the anterior septum separating somites xi and xii. The lobing of these sperm-sacs is much greater than those in the somite ix. These sperm-sacs are not connected with those in somite x and xi. The latter sperm-sacs are entire, not lobed. They are only present in very mature worms and are of variable size. When fully developed they fill the larger part of these somites, which are besides crowded by the hearts, testes, ciliated rosettes, etc., found in them. The presence or absence, relative size or form, of the sperm-sacs in somites ix and xii appear to afford good species characters. In *Ocnerodrilus occidentalis* they are entirely wanting in somites ix and xii. In the other species described here as new these sperm-sacs are present, their lobation at least in its general traits, being characteristic of the species.

Sperm duct and *ciliated rosette.* There are two pairs of ciliated rosettes, one pair in somite x and one pair in xi, corresponding to the testes (fig. 18). The rosettes are placed behind and close to the testes, and their structure offers nothing unusual. They resemble each other in all the species, are very large and delicate, spreading over the lower parts of the hearts, but free of the septa. The inner cells are large rectangular, with large oval nuclei and long cilia. The sperm ducts pass backwards and unite imperfectly with each other in somite xi or xii, and continue from that on as one duct to somite xvii, where are situated the male or spermiducal papillæ, and in which also opens the prostate gland (or atrium). The sperm ducts are closely following the body wall, do not run straight, but in a wavy, snake-like way, but are not coiled. (In fig. 1 they are represented as straight in order to make the fig. clearer.) The male papillæ, of which there is one pair, occupy the same place as the inner setæ in the respective somites. There is only one seta left, the other, the outer one, being abortive. The single remaining seta is not differentiated. In three of the species, the penial setæ are wanting, while in *Ocnerodrilus occidentalis* and other species they are either both present or one is wanting. The sperm ducts which in some species are enlarged in the vicinity of the male pore, are in this species of even width throughout their length. The ducts are only imperfectly joined.

While forming one single tube as far as their outward form is concerned, they still remain separated, the ciliated lumen of each being readily visible even close to the papillæ (fig. 57). The absence or presence of a enlarged and differentiated lower part of the sperm ducts is of the greatest importance as a species characteristic. A similar modification of the sperm duct is found in Pygmæodrilus. The *prostate gland* is smaller than in most other species, except in *Ocnerodrilus guatemalæ*. In *Ocnerodrilus occidentalis* it passes from somite xvii to xxiv, or further yet; but in *Ocnerodrilus Beddardi* it occupies only two or three somites, and in *Ocnerodrilus guatemalæ* only one. It is bent several times on itself (in this there is no constancy) and ascends first upward. The inner epithelial lining consists of only one layer of tubular cells similar as in the other species and as in Gordiodrilus.

There exists in the prostates of the various species two more or less differentiated parts. Generally there is an upper only glandular part and a lower part which is muscular and which connects with the male pore. In these species, *Ocnerodrilus sonoræ* and *guatemalæ*, this lower part is much less differentiated, containing tubular glandulous cells, and this part of the prostate differs only in the addition of two muscular layers. In the other species the muscular part of the prostate is much differentiated and entirely void of the tubular glandulous cells, so characteristic of the upper part of the prostate in all the species.

In *Ocnerodrilus Beddardi* the lower part of the prostate is narrower, slightly tapering towards the purely glandular part (fig. 55). In *O. sonoræ* (fig. 59) the lower muscular part is thicker than the upper glandular part, gradually decreasing in size towards the distal end. The prostate of *O. guatemalæ* is only half as long and about one-third or one-fourth as wide as this organ in any of the other species and very characteristic in appearance (figs. 65 and 66). At the apex of the male papilla there is a small gland without any visible lumen.

The *ovary* is situated in somite xiii, as is generally the case in Oligochætæ. It is attached to the anterior septum. The disposition of the ova is the general one, the larger ones being on and towards the outside and upper margins of the ovary with the smallest ones further in. The ovary is pressed close to the parietes of body.

The *oviduct* consists of one pair of trumpet-shaped organs in somite xiv, one for each ovary. The ovipore is situated in this somite, opening outwardly in front of the inner setæ. The interior funnel opens into somite xiii, in close proximity to the ovary, and is engaged in the septum between somite xiii and xiv. It offers no great peculiarities in its structure, but is more rounded than in *Ocnerodrilus occidentalis* (fig. 17).

The *spermathecæ* (fig. 1, 27, 28, 29) consist of one pair of flask or club-like bodies, situated in somite ix, opening externally behind the anterior septum in the intersegmental groove between that septum and the viii. The shape is flask or club-like, thickest at the inner free end, gradually tapering towards the spermathecal pore. It is narrowed at the middle and furnished with a varying number of diverticula, from two to six. These diverticula are short, of various length, but never as long as the width of the spermatheca at the point of attachment. The smallest ones are wartlike. They are mostly situated at the upper broader end of the organ, and rarely more than one is found further down. In the diverticula the spermatozoa are seen massed. The inner lining of the spermatheca consists of tubular cells, which in cross-section appear circular, with large round nuclei. The outer lining is very thin, with few nuclei. The lower part of the spermatheca is muscular, and appears to be constructed as in Gordiodrilus. There are a few minute oblong glands at the base of the spermatheca, at its junction with the body wall. The external spermathecal papilla is, at full maturity, quite large and prominent. The form and existence of the spermathecæ offer important characteristics of specific value. In *Ocnerodrilus Beddardi* and *limicola* there are small diverticula. In *O. agricola*, *O. Rosæ*, etc., the spermatheca is round, or cylindrical, with no diverticula, while in *Ocnerodrilus occidentalis* the spermathecæ are entirely wanting. In all the species examined by me the spermathecal porus is situated in somite ix, but in the species described by Beddard the porus, as well as the organ itself, appears to be in somite viii.* The structure of the spermathecæ in the various species is very much the same; in *O. sonoræ* the muscular part is wanting.

The *spermatozoa* are found with moderately long, straight, not wavy or screw like, tails.

Nervous system. The chephalic ganglion is about four times broader than high, emitting a large, generally three-forked branch, towards the prostomium. A network of bloodvessels emanating from the upper branches of the lateral vascular trunks and from the dorsal vessel, is spread over the cephalic ganglion in a way similar to what is found in *Ocnerodrilus occidentalis.* The ventral ganglion emits one pair of lateral ganglia in each somite. The pharyngeal plexus emits one pair of ganglia upwards to the pharynx, and one pair laterally towards the body wall.

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* There is some uncertainty as to its location. Beddard says once that it is found in somite ix, while three or four times the statement reads in viii. The former probably is a misprint.

Ocnerodrilus guatemalæ *n. sp.* Fig. 61, 62, 63, 64, 65, 66, 76.

The *clitellum* is small from somite xiv to xviii. The body is long, slender, of even thickness throughout, with a glossy lustre, and of dark opaque brown when preserved in alcohol. In this it differs from *O. agricola*, which always preserves its light and semi-transparent color. The size is about one and a fourth inch by three-fourths line long, of course with some variations. It is one of the longer and slender worms.

The septal gland in somite v is almost twice as long as the one in somite vi. It is deeply lobed; this is also the case with the other glands. The size of the anterior gland is very characteristic. The gland in somite vii is much smaller, and resembles, in its proportions to the surrounding glands, those of *Ocnerodrilus Hendriei*, from which it, however, differs in the lobing of the glands. In *O. Hendriei* they are almost entire, while in the present form they are deeply lobed. The glands in vii and viii are small, of almost equal size, but the one in vii, as usual, is the smallest of the four.

The *spermatheca* is very small, the smallest found in any species. In fully matured specimens the height of the spermatheca is not quite equal to the width of the œsophageal diverticulum. The form is very much like that of *O. sonoræ*, but the size is even smaller, and as it is generally lying flat against the parietes, it may be easily overlooked. The lower part of the spermatheca is narrower than the corresponding part in *O. sonoræ*, and the whole organ is darker and more opaque. There is only a trace of diverticula, the wall being slightly sacculated. This species stands near *O. Beddardi*, *sonoræ* and *Hendriei*, but its characters appear very constant, in specimens collected several hundred miles apart, and I do not hesitate to classify it a well-defined species.

The *prostate gland* is one of the most characteristic parts of this species, but unhappily all the specimens were considerably macerated, and the finer structure could not be made out. Specimens from Tamaju, in the highlands of Coban, showed the same characteristics as the specimens from Guatemala city, and I believe the form and size of the prostate constant. In structure the prostate gland agrees with the same organ in *O. Beddardi*, *sonoræ* and *Hendrici*, but in size it is quite distinct, being even smaller than the prostate in *O. Hendrici*. At the male papilla it is only about four times as wide as the width of the seta, and at the inner apex it attains double that size. It gradually increases in size from the male pore, but still it is very slender, and compared to the prostate of *O. Beddardi*, is not half as long and less than one-third as thick. It is entirely confined to one somite. The structure appears to resemble that of *O. Beddardi*, the lower or narrower part being furnished with tubular glands, resembling those of the upper muscular part only smaller.

There is a seta close to the male pore. The outer one in the pair is wanting. In this it differs from *O. Beddardi*, in which the inner seta of the couple is wanting, but resembles *O. sonoræ*. It also differs in this respect from *O. Hendrici*, in which species both setæ of the inner couple in somite xvii are wanting. There is no enlargement of the sperm duct at the male pore.

Habitat. In garden soils in the city of Guatemala, Central America, April, 1882. Also at Tamaju, on the river Polochic, on the Atlantic side of the same republic. In Guatemala city it occurred in the same locality as *O. agricola*, but was found about a month later. It is a real soil species, and I never found it in wet places.

Ocnerodrilus sonoræ, *n. sp.* Fig. 57, 58, 59, 60, 71, 73, 75.

This species comes nearest *Ocnerodrilus Beddardi*, *guatemalæ* and *Hendriei*. Some ten specimens collected agreed in the following characteristics:

The *septal gland* in somite v is of almost the same size as the one in somite vi and this one again is only little larger than the one in vii. The septal gland in somite viii is higher than in *O. Beddardi* and is only little smaller than the gland in somite vii. All the glands are less lobed than in *O. Beddardi*.

The *spermatheca* (fig. 71, *spth.*), is of about one-half the size as in *O. Beddardi*, almost bag-like, very much flattened and with no trace of diverticula. There is no differentiated muscular part of the lower portion of the organ, the whole being of the same structure. The spermatheca is about as long as the diverticulum is wide. It is very transparent, and shows much smaller and more irregular cells than the same organ of *O. Beddardi*.

The *sperm-sac* (fig. 71, *s. s.*), in somite ix is large and somewhat lobed. The sperm-sac in somite x is the smallest of the four. The one in xi is larger, but not as large as the one in ix. The sperm-sac in somite xii is very large, much larger than the others. It is lobed and fills the whole of the somite. In no other species is the sperm-sac in somite xii of such size: the size appears to be constant.

The *sperm duct* has no enlargement at the male pore.

The *prostate* is short as in *O. Beddardi*, but it is more cylindrical and the muscular part is not tapering toward the glandular part, but on the contrary the prostate is gradually increasing in size from the inner apex towards the male pore, and the muscular part is in no way differentiated as regard outline. This I consider a good species characteristic of small variability. The prostate is much twisted and confined to two somites. In the inner couple of setæ in somite xvii the outer seta is wanting.

The *œsophagus* is greatly nipped by the septa, is much sacculated and is wider than in any of the other species. The *clitellum* is very short comprising xiv, xv, xvi, xvii, as in *O. agricola.*

The most characteristic features of *Ocnerodrilus sonoræ* are: the very large sperm-sac in xii; the sacculated œsophagus; the form and size of the spermatheca.

Habitat. In moist soil near irrigation canals in San Miguel de Horcasitas, Sonora, Mexico. As *Ocnerodrilus Beddardi* appears to be confined to the Cape region of Baja California in the vicinity of San José del Cabo, so is *O. sonoræ* to date only found on the mainland of Sonora, Mexico.

Ocnerodrilus Hendriei, *n. sp.* Fig. 38, 39, 72, 77, 83.

Clitellum begins at the center of xiii and extends to center of xviii, thus comprising four whole and two half somites.

Size of worm about 1½ inches by ¾ line.

Spermathecal pore in somite ix as usual.

Ovipore in xiv and *spermiducal pore* in xvii as usual.

The inner couple of the setæ in somite xvii is wanting.

The *septal glands* differ from those of other species described in this paper. The anterior one in somite v is large, much larger than the one in somite vi. This again is much larger than the one in somite vii which again is of nearly the size as the one in somite viii, both being very small. The characteristic points in these glands are thus the unusually small size of the two posterior glands in somite vii and viii or in fact the comparatively small size of the three posterier glands compared to the anterior gland in somite v, this gland being of about the same size as in other species. As regards the lobing of the glands, it resembles that of *O. Rosæ*, that is the glands are almost entire, but the relative size of the gland is very different from what is the case in that species. In *O. Rosæ* the gland in somite vii is much larger than the one in somite viii while it is of nearly the same size as the one in somite vi. From *Ocnerodrilus guatemalæ* which this species resembles perhaps more than any other, it is distinguished by more entire septal glands, by a smaller spermatheca, etc.

The *sepermatheca* is very small, about as long as the diverticulum of the œsophagus is wide. It is contracted on two places and greatly resembles the same organ in *O. limicola*.

The *sperm-sacs* occur in ix, x, xi, xii. The one in somite ix, as usual, situated principally above the diverticulum, is very large, filling the whole of the upper part of the somite. It is entire, not lobed. The sperm-sacs in x are smaller, or even absent. but the one in vi is again very large, occupying a large part of the respective segment. The one in xii is situated as in the other species, and is deeply lobed, but as regards size is much smaller than the one in somite xi. In *O. sonoræ* the sperm-sac in somite xii is very large.

The *prostate gland* is short, running through about two somites. The muscular part is very small and the lower part of the sperm duct is not enlarged. The specimen being much macerated, I am not able to give a very accurate description of these organs. There is a very small zone around the male pore, partly extending ventrally. The inner couple of setæ in somite xvii is wanting (fig. 72).

As regards the size of the prostate, *O. Hendrici* and *guatemalæ* resemble each other more than they do other species. *O. Hendriei* has the largest prostate of the two, about as large again as the one in *O. guatemalæ* (fig. 65, 66 and 83).

The *vascular system* resembles that of *Ocnerodrilus limicola*, and there is a large connecting vessel, evidently a pulsating one, in somite ix, just behind the diverticulum of the œsophagus. But this vessel is larger than in *O. limicola*, and partakes in shape and size of the nature of a heart, much resembling the one in the somite posterior to it.

Habitat. Santo Tomas, Guatemala, Central America, between Salama and Coban, on the road after a rain.

Ocnerodrilus limicola, *n. sp.* Fig. 31, 35, 47, 53, 78.

The *Clitellum* comprises at least five somites, extending from xiv to xviii, and encroaching on somites xiii and xix.

Spermathecal pore in somite ix, as usual, in the groove between that and somite viii.

Ovipore in somite xiv.

Male or *spermiducal papillæ* one pair in somite xvii, and a pair of prostate papillæ in somite xviii. The zone surrounding the papillæ is small, and does not extend across the ventral region, as in *O. agricola*.

The *septal glands* are in somites v to viii, as usual. The anterior three glands are the largest, of nearly equal size, but the one in somite v is slightly longer. All the glands are characterized by being much more deeply lobed than in any other species, even more so than in *O. Beddardi* and *guatemalæ*. The posterior gland in somite viii is, as generally, the smallest.

Spermathecæ (fig. 31-35, *s. spth.*) one pair in somite ix. This organ is smaller in this species than in any of the other which possess spermathecæ, except *O. guate-*

malæ. The form is irregular, cylindrical, contracted in several places, and with a few only slightly elevated or wart-like diverticula, hardly differentiated from the main pouch. In general appearance it comes nearest to that of *O. Beddardi*, but it is smaller, and the diverticula are less prominent.

The *testes* are in somites x and xi, and offer no peculiarities. The *sperm-sacs* are very large, and always fill the somites ix to xii. The sperm-sac in somite ix is situated as in *O. Beddardi* and *O. agricola*. It is deeply lobed as in these species. The sperm-sacs in somite xii are similarly situated and lobed as in the species just referred to. *Ovary* and *oviduct*, as usual, respectively in somites xiii and xiv.

The *clitellum* does not show the peculiar zone around the male pore as in *O. agricola*, and the male papilla is very small and not prominent.

The inner pair of setæ in somite xvii is wanting, similarly as in *O. agricola*, *Hendriei*, etc.

While all other species contain only one pair of prostate glands, *O. limicola* possesses two pair, one in somite xvii and one in xviii. The one in somite xvii opens in the male pore, together with the sperm duct. In *Gordiodrilus robustus*, as lately described by Beddard, there are two prostates on each side opening in two consecutive somites, but only one pair of sperm ducts, both sperm ducts opening in one pore. The prostate itself is unusually narrow at the distant end, thicker at the middle, and then again gradually tapering towards the muscular part. This muscular part is narrowest close to the glandular part, from which it gradually increases in size towards the male pore (fig. 53).

The sperm ducts are not enlarged close to the pore, as in at least three other species, *O. agricola*, *Rosæ* and *contractus*.

The inner couple of the setæ in somite xvii, close to the male pore, is generally full, though in some specimens there was only one seta. The pair in xviii is also present.

A most important characteristic of the species is a connecting secondary vessel in somite ix. In other species, except *O. Hendriei*, so far known, the two pair of hearts in somites x and xi are the only four secondary vessels which connect the dorsal and ventral vessels. But in *O. limicola* we find one pair of large vessels in the posterior part of somite ix, just behind the diverticulum, which connects the two main vessels. This connecting pair is cylindrical of almost even width, and evidently does not pulsate, or pulsates only weakly, judging from its appearance in preserved specimens (fig. 31, *c. v*).

In size *Ocnerodrilus limicola* stands between *O. Beddardi* and *O. agricola*. It is decidedly smaller than *agricola*, especially as regards the part anterior to the clitellum. Too much importance must not be placed on the size of any of the species, as they vary considerably, and the smaller individuals are equally sexually developed as the larger specimens.

Habitat. This worm I found in a clear running mill-race and pond at El Portal, a hacienda close to Antigua Guatemala, in Guatemala, Central America. It appears to be strictly a water species as I did not find it in the drier soil outside of the pond. All the other species hitherto known either live both in water and in drier soil, or in soil only, and must be considered as semi-aquatic or terrestrial.

Ocnerodrilus Eiseni Beddard.

This worm lately described by Beddard differs, according to that author, from the other species as regards the following points: *Clitellum* extends from somites xiii to xviii, and does not encroach on the adjoining somites. Such distinct clitellum is not possessed by the other species, in all of which the clitellum encroaches on the adjoining somites. The inner pair of *setæ* in somite xvii is wanting entirely. In this respect this species differs from many other species, except *O. agricola*, *Hendriei* and *contractus*, which all possess this characteristic.

Spermathecal pore between somites vii and viii, and the *spermathecæ* in somite viii, are smaller than the spermathecæ in *O. agricola*. All other species possessing spermathecæ have this organ (one pair) situated in somite ix. No spermathecal diverticula. *Ovipore* in xiv and *oviduct* in the same somite, opening with the funnel in xiii behind the ovary. No enlargement of the sperm duct close to the male pore. Prostate with a long, narrow, muscular tube.

Buccal cavity extends through three somites and the pharynx to the fifth, as in other species. The buccal cavity of all species examined by me appears shorter, though the want of septa makes the limits uncertain.

The *œsophagus* is widened at the junction of the diverticula, which is not the case in the other species, at least not to the same extent. The ciliated tubular intestine is narrower than the œsophagus, and differs in this from other species, all of which have the œsophagus and tubular intestine of more or less the same width.

Nephridia degenerate in somites x and xi, as is the case to a greater or lesser degree in other species, and the posterior nephridia are enveloped in large peritoneal cells.

Testes in somites x and xi.

Habitat in soil, not in water.

As will be seen from the above characteristics this species differs from all others in having the spermathecæ in somite viii. It undoubtedly comes nearest to *O. agri-*

cola, the spermathecæ of the two species being of the same general form, but much larger in *O. agricola*. The clitellum in the latter species is also the smallest.

Ocnerodrilus Rosæ, *n. sp.* Figs. 23, 24, 25, 26, 36, 48, 79.

This is a small species, in size a little longer but not any wider than *Ocnerodrilus occidentalis* or about 1 inch by ¾ line. The body-wall is peculiarly thin, especially in somite xii, and more transparent and less tough than in *O. occidentalis*. *Clitellum* commences at the anterior ⅓ or ¼ of somite xiii and extends to xviii. There is no ventral zone surrounding the male pore as in *O. agricola* which this species otherwise comes near.

The *setæ* are as usual, and the inner couple in somite xvii is wanting.

Spermathecal pore in xix.

Ovipore as usual in xiv and *Spermiducal* or *male papillæ* (one pair) in xvii.

This species appears to form a group with *O. contractus* and *agricola*.

The upper part of the peristomium is longer than the second somite, but the prostomium appears smaller than in other species. The *buccal region* extends to the posterior part of somite ii when the worm is contracted.

Pharynx occupies somites iii, iv and v and is as usual very muscular and glandular, but the salivary glands on the upper side are much larger than in any other species, projecting backwards and encroaching on somite v in such a way that the septal gland in this somite is pushed backwards into somite vi.

The four septal glands in somites v–viii are smaller than in other species and crowded together in the space below three segments. In other words, the salivary glands are larger and the septal glands are smaller than in other species. In reality they are confined to the same somites as other species of the genus.

The anterior septal gland in somite v is hardly any larger than the one in somite vi. The one in vii is hardly lower than the one in vi, while the septal gland in somite viii is much higher than in other species except *O. occidentalis*, but with a much smaller base. The anterior septal gland has the broadest base, those following have shorter bases, and the last one in somite viii has the shortest base of all; this is the opposite of what is the case in the other species. But this peculiarity is not the only one as regards these glands. They are all of them less lobed than in any other species except perhaps *O. occidentalis* and *Hendriei*, the anterior gland in somite v being especially entire and continuous in outline.

The *œsophagus* which in most other species is tubular and hardly contracted is in this species very much nipped by the septa. Its walls are also thicker except in somite xii where they are remarkably thin and transparent. In this somite also, the tubular intestine (or posterior part of the œsophagus) is narrower, the sacculated intestine commencing first in somite xiii, where, as usual, is also found the ovary. The inflation of the sacculated intestine is not any greater in somite xiii than in any of the other clitellial somites.

Testes in x and xi as usual.

The *sperm-sacs* are small, of undecided form situated in the upper part of somites ix, x, xi and xii. The anterior and posterior sperm-sacs are not deeply lobed. In this respect the species differs from all the others.

The *spermatheca* (fig. 23–36) is long, cylindrical, of even outline, thick and opaque, without any trace of diverticula. It resembles that of *O. agricola* in this respect, but in shape it is entirely and characteristically different from the one in that species. It is about one-third as thick and three-fourths as long as the diverticulum of the œsophagus. The spermatheca of *O. agricola* is about one and one-half times thicker than the diverticulum, and almost globular in outline.

The *ciliated rosettes* are in this species smaller, as compared to those of other species.

The *prostate glands* are very slender and twist considerably, extending behind the clitellum, or as far as the end of somite xx. In width they are about the size of the widest part of the ventral ganglion. The *prostate* consists of two distinct parts; the more distant one, which is glandular, and the one nearest the male pore, which is muscular. The glandular part is by far the longest, as well as the widest. In form it is cylindrical, of the same width throughout its length, and not tapering as in some other species. This glandular part consists of a single layer of epithelial cells, just as in all other species.

The muscular part is in this species very long, occupying about the length of one and two-thirds somite, and about one-third or one-half longer than the enlarged part of the sperm duct. In width the muscular part of the prostate is slightly narrower than the glandular part. It is also more transparent. The transverse muscles are very conspicuous (fig. 24), enclosing a large, regular and well defined lumen. The prostate and the sperm duct are entirely independent of each other until they reach the male pore, in which they both open apparently separately.

The muscular part of the prostate is a little less than one-half as long as the glandular part, and somewhat narrower. It is narrowest close to the glandular part, and then becomes wider towards the male pore. The greater part, however, is of even thickness. In the vicinity of the male pore it narrows considerably, but widens again nearer the pore. The interior lumen of the muscular part is much wider close to the glandular part of the prostate. The walls of the muscular part consist of spirally wound muscles, which enclose a row of glandular bodies arranged at intervals in globular masses around the lumen (fig. 25).

Sperm ducts. The most important character of *Ocnerodrilus Rosæ* is connected with the sperm ducts. In all the others, except *O. contractus* and *agricola*, the two ducts on either side unite in somite xii into one continuous duct, of equal size and thickness throughout its course, and even in the somite of the male pore (xvii) is in no prominent way differentiated. But in *Ocnerodrilus Rosæ* the sperm-tube is prominently modified in xvi and xvii. It is there enlarged to about five or six times its original or usual size, forming a kind of long, cylindrical, shuttle-like at both ends, tapering enlargement, the lumen of which is somewhat wavy and as wide as the sperm duct before it enters the enlargement. The transition between the narrow and the wide part of the duct is short, but gradual. Compared to the prostate gland, this enlargement of the sperm duct is about one-fourth wider than that organ at its widest point. It is flat or compressed, and when in its natural state lies closely pressed to the parietes of somites xvi and xvii, parallel to the ventral ganglion. In length this enlargement reaches from the middle of somite xvii to the anterior end of somite xvi, thus occupying a length of almost, but not entirely, one and one-half somite. The enlargement is about one-third wider than the widest part of the ventral ganglion in the same somite.

The enlargement consists of a heavy longitudinal layer of muscles, composed of small, shuttle-like cells, arranged longitudinally. These directly enclose the original duct. A transverse layer of muscles surrounds the whole enlargement.

Habitat, under damp moss at springs at San Antonio, near the city of Guatemala, Central America.

Ocnerodrilus contractus, *n. sp.* Fig. 42, 43, 45, 50, 51, 52, 67, 80.

Clitellum occupies xiii–xviii. The inner pair of setæ in somite xvii is wanting. One very elevated papilla and a narrow half-moon like groove around the male pore, but no ventral zone.

The *septal glands* resemble those of *O. occidentalis* and *O. Rosæ*. The gland in somite v is not larger than the one in vi, but somewhat smaller. The gland in somite vi is the largest of the four glands. The gland in somite vii is of nearly the same size as the one in somite v, or slightly smaller. The gland in somite viii is, as usual, very small as to height. but not as narrow of base as the corresponding gland in *O. Hendrici*. All the glands are only slightly lobed, almost entire in their margins. The relative size of the septal glands distinguishes this species from *O. Hendrici*.

The *salivary glands* of the pharynx are rather deeply lobed, the lower glands being the largest ones.

The septa supporting the septal glands vary in size, and are all much thinner than for instance in *O. Hendrici*. The one between viii and ix is the thickest. The one between viii and vii is much thinner, and those between v and vi and vi and vii are the thinnest, both being of nearly equal size.

The *spermatheca* is cylindrical, rather even in outline. It is larger than the same organ in *O. Hendrici*, but not as large as in *O. Rosæ*, though of about the same form as in that species. The length of the spermatheca is not quite equal to that of the œsophageal diverticulum, while in *O. Rosæ* it is longer than the said diverticulum. These measurements refer to sexually mature species. The lower part of the spermatheca is narrower and muscular, the muscles being arranged in two directions. The outer circular layer is the thickest, and reaches only to the pouch part of the spermatheca. It contains large round nuclei. The longitudinal layer extends all around the spermatheca, and is narrower than the inner epithelium of the pouch. The cells of the epithelium are narrower and less regular than in *O. Beddardi*.

The œsophagus is contracted at the septa similarly as in *O. Hendriei* and *Rosæ*. The sacculated intestine begins in somite xii, and differs in this respect from *O. Rosæ*, in which species it commences in somite xiii.

The *sperm-sacs* are large, and in mature specimens constant in size and are characteristic of the species. The one in somite ix consists of an enormous sac, not lobed, which fills the whole somite. The sperm-sac in somites x and xi are narrow, but long, reaching from the dorsal to the ventral parietes. The sperm-sac in xii is lobed, and attached in the usual way to the anterior septum. In *O. Rosæ* the sperm-sac in somite x is generally wanting, and always, when present, is of very small size.

The *vascular system* resembles that of other species, but there is no connecting vessel in somite ix, as in *O. Hendriei* and *limicola*, which former species the present form otherwise much resembles. From *O. limicola*, which possesses this connecting vessel, the present species is distinguished among other things by its almost entire septal glands, by one pair of prostates, etc.

The lower part of the *sperm duct* is muscular, enlarged and shuttle-like, in very much the same way as in *O.*

Rosæ and *agricola*. But the relative length is not the same. In *O. contractus* this muscular swelling of the sperm duct is as long as the muscular part of the prostate, while in *O. Rosæ* this part is about one-fourth to one-third smaller than the muscular part of the prostate.

The lumen also is wider in this species than in *O. Rosæ*. In *O. contractus* the lumen is considerably wider than the narrow part of the sperm duct, while in *O. Rosæ* the lumen is narrower than the sperm duct proper. In *O. contractus* the lumen occupies about one-third of the enlargement, while in *O. Rosæ* it occupies only about one-sixth or one-seventh. The enlargement consists of two additional layers, one exterior of transverse muscles, which part is very thin, and one interior of longitudinal rhomboid cells, arranged obliquely.

The *prostate* is long, cylindrical, not tapering, with a long muscular lower duct, of similar form and construction as in *O. Rosæ*. This muscular part of the prostate is of the same length or slightly shorter than the muscular part of the sperm duct. The glandular part of the prostate is shorter than in *O. Rosæ*, or about one and one-half times larger than the muscular part. In *O. Rosæ* it is over twice as large as the muscular part.

The *ovary* is in xiii and the oviduct in somite xiv, as usual. The ovary, affixed to the anterior septum, contains very large globular or circular ovæ. The oviduct is almost straight, gradually increasing in size towards the funnel, which is not distinctly set, widened or reflected.

The *cephalic ganglion* is in somite iii, and the infrapharyngeal ganglion, which is very large, is between somites iii and iv, as usual.

Habitat, in pools close to the road, near Llano Grande, in Guatemala, Central America.

Ocnerodrilus agricola, *n. sp.* Figs. 34, 41, 44, 46, 54, 81.

Clitellum is very small, occupying only four somites, from xiv to xvii, inclusive, sometimes transgressing on the adjoining somites xiii and xviii. But the shortness of the clitellum is not its only characteristic. It does not extend to the region nearest the ventral ganglion, as in the other species, but immediately around the male pore in somite xvii it shows a half-moon like margin, leaving a round disk-like zone surrounding the male pore. But this zone is much thickened, of a somewhat different structure from the clitellum. The specimens having become much macerated, I could not fully make out this structure, but it occupies the whole width of somite xvii and part of xvi, on which latter it curves with a concave sweep towards the anterior part of that somite.

Spermathecal pore in somite ix, close to the septum and in the inter-segmental groove.

Spermiducal papillæ, one pair in somite xvii.

Ovipore in somite xiv.

The anterior *septal gland* in somite v is longer and broader than the one in somite vi. The septal gland in somite viii is very low, and is the smallest one of the four glands. The anterior gland is less lobed than in *O. Beddardi*, or in *O. guatemalæ*.

The *septa* in the gland bearing somites are, as usual, thicker than the other septa.

Spermathecæ, one pair, are found in somite ix. In shape the spermatheca differs from those of the other species, in being almost globular without any diverticula, and of a size at least twice as large as the spermatheca of *Ocnerodrilus Beddardi*. In general shape it agrees with the same organ in *O. Eiseni*, as described and figured by Beddard, but it is larger and more globular, apparently but little varying in shape or size in sexually mature worms. The lower part of the spermatheca is muscular, but there are no glands at the base. The spermatheca fills the whole width of the somite.

Testes are found in two pairs, one in somite x and one in xi, of the same shape and size as those in *O. Beddardi* and other species.

Sperm-sacs are found in somites ix, x, xi and xii, of the same general form as those of *O. Beddardi*. The sperm-sacs in somite ix are globular and lobed, but not as much so as those in somite xii, which are deeply lobed, and closely cover the anterior end of the sacculated intestine like a collar. The sperm-sacs in *O. Beddardi*, *agricola* and *guatemalæ* are all very similar. They do not enclose nor even cover the testes, and the anterior and posterior sperm-sacs are not connected with the middle ones. These latter are unusually large in this species, occupying the whole space in somites x and xi between the body-wall and the other organs. They are larger than in any other species of Ocnerodrilus.

The *ciliated rosettes* and *sperm ducts* resemble those of *O. Rosæ* and *contractus*, but the prostate glands are much longer, extending from somite xvii to xxviii, as in *O. occidentalis*, to which species, however, the present worm shows no other affinity. The sperm duct is enlarged, or rather is surrounded by a muscular swelling close to the male pore. The enlargement is about one-third as long as the muscular part of the prostate.

The muscular part of the prostate is very long, covering approximately two somites or more, while the glandular part of the prostate extends through nine somites. In the other species with similar structure of the male organs, the prostate is much shorter. Thus in *O. Hendrici* and *contractus*, the glandular part of the prostate does not exceed two and one-half times the muscular part, while in the present form the glandular part of the prostate is about four times as long as the muscular part.

The *ovary* and *oviduct* are, as elsewhere, situated in somites xiii and xiv, and offer no peculiar characteristics.

The inner couple of the *setæ* in somite xvii is wanting. The species is easily and best characterized by the large globular spermatheca in somite ix, which is so large that it obstructs the view of the œsophageal diverticulum.

The body-wall of *Ocnerodrilus agricola* is very thin, much more so than in other species; it is also quite transparent and white. As to size, this species is thicker than any other. Epecially the anterior part is thicker than the corresponding part of *O. Beddardi*.

Habitat. Guatemala City, in Guatemala, Central America, in garden soil. This species was never found in running water, but always in moderately dry places.

Ocnerodrilus occidentalis, *Eisen.* Figs. 15, 16, 21, 22, 68, 69, 70, 82.

Clitellum occupies six to seven somites, from xiv to xix, sometimes encroaching on somites xiii and xx. It is not always present, even in sexually mature specimens.

No *spermathecal pores* or *spermatheca*. *Spermiducal* or *male papillæ*, one pair in somite xvii. The inner couple of setæ in somite xvii present; *ovipore* in somite xiv—one pair; *septal glands* in somites v, vi, vii and viii. The glands respectively in somites v, vi and vii are of about the same size, while the one in somite viii, which is generally in other species much lower, is in this species of about the same size as the anterior glands. The gland in somite v is not longer than those in vi and vii, and all the glands are less lobed than in other species.

The testes and sperm-sacs are differently arranged in

Ocnerodrilus occidentalis than in any other species so far known. Instead of two pairs of testes there is only one pair. This one situated in somite x, attached to the anterior septum. It is of the same general structure as the posterior testes in *O. Beddardi*, small, thin and heart shaped. Instead of a pair of testes in somite xi, as might be expected from analogy with other species, we find in this somite a pair of small sperm-sacs, which might be mistaken for testes, and were so at first considered by myself. They are attached to the anterior septum, varying in size, but always only slightly larger than the testes, and never attaining to the size of the sperm-sacs of the other species. This sperm-sac, which is situated in line with the testes in the somite in front, is rounded, almost globular, with a more or less irregular surface, like a more or less inflated or collapsing balloon. It is furnished with a lower duct, which consists of a muscular and glandular layer of cells which in the duct are strongly ciliated. This duct reaches only to the septum in somite xi, and then connects from there with the anterior testes. I suspected first that this muscular duct connected with the exterior through the body-wall, in which case the sperm-sac would have served also as a spermatheca, this organ being absent in this species, but I could not find any connection between it and the body-wall.

The lobed sperm-sacs which in other species are found in somites ix and xii, are not found in this species, nor is there a pair of sperm-sacs in x, as in all other species.

The *prostate* gland is very long, several times bent on itself, and extending from somite xvii to xxvi, when fully developed. The ciliated rosettes are in somites x and xi, behind the testes and sperm-sacs. The sperm ducts pass posteriorly and open with the prostate in somite vii.

The seta of the inner couple in this somite are both present (fig. 68). There are no spermatheca.

Ovary in xiii and *oviduct* in somite xiv. The inner opening of the oviduct is found in somite xiii, close to the ovary. It is of less rounded form than in *Ocnerodrilus Beddardi*.

The *nephridia* are much smaller than in any other species, and occupy only about one-fifth of the whole width of the somite, while the nephridia in most other species are very large, occupying the larger part of the somite, the upper part of the nephridium of *O. Beddardi* covering the whole width of the somite from septum to septum. Those in front of and in the clitellum, except the one in somite ix, are not surrounded by any peritoneal cells. Those posterior to the clitellum are furnished with a few such cells along the upper part of the nephridium, the long, slender lower part being entirely free. The quantity of such cells varies greatly with maturity of the individual. In many specimens they are hardly traceable, in others they are more prominent, but never to such an extent as is the case in any of the other species, where this glandular covering is most copious. As a rule, in the sexually mature worms the peritoneal cells are more numerous. In younger worms of *O. occidentalis* I could find no trace of them. The nephridium in somite ix is always at sexual maturity furnished with peritoneal cells, but only along its upper part. This is in analogy with the development of the nephridia in *Ocnerodrilus Beddardi*, where the nephridia in somite ix are larger than any others anterior to the clitellum.

The *alimentary canal* offers the same characteristics as in the other species, but the anterior portion is much more contracted and shortened. Thus the pharynx is more globular, and the œsophagus and the tubular intestine are thicker than in *O. Beddardi.* The tubular intestine is considerably nipped by the septa. The sacculated intestine commences in somite xii, and the inflation is widest in the anterior somites, as in the other species. The body-wall is much tougher than in any other species.

Size of worm, about three-fourth inch long by three-fourth line wide.

From the above it will be seen that *O. occidentalis* differs in many important points from all other species known. The septal glands in viii are very large, in all other species they are very small, compared to the anterior glands. Spermathecæ are absent. Sperm-sacs in ix, x and xii are absent. The one in xi is differently situated and of a different structure from those in any other species. The nephridia are smaller than in other species. The number of bloodvessels in the œsophageal pouch are less in number than in other species. The pouch itself at its attachment to the œsophagus is not, or only a trifle, narrower than at its greatest width, while in all other species the pouch is much narrower at the attachment than elsewhere (fig. 84).

With an increasing number of species known, it may be necessary to arrange them in sub-genera, though at present any subdivision of the genus would be superfluous.

Habitat. California, San Joaquin valley, at Fresno, in garden soil. It comes to the surface when irrigation is practiced. So far only found in the garden of the Eisen Vineyard, six miles east of Fresno. As I have in vain looked for it elsewhere, it is possible that this worm has been introduced there from some other locality with plants, though I believe that the native habitat of the worm is in California, as at the time of the first find no foreign plants had been introduced.

SETÆ.

But little mention has been made of the setæ of the different species. As species characters they are of limited value, principally on account of the difficulty experienced in describing them properly, but also on account of the small variation between the different species. In all the species the setæ are sigmoid of the lumbricid pattern, and in their general form there is but little or any difference between those of various species. But in size the difference is greater, as may be seen from figures 74 to 82, where are represented the setæ of all the varieties described by me. All the figures have been drawn to the same scale (about 750 diameters) by means of a camera, and are as exact as it was possible to make them. The margins in all the forms are more or less wavy, in some there is only a suggestion of undulation, in others again the outlines are distinctly wavy. A comparison of the figures will give a better idea than any lengthy description. It will suffice to say that the anterior or free ends of the setæ are more wavy than the posterior parts. The setæ of *Ocnerodrilus Hendriei* are more wavy than those of any other species (fig. 77), and are besides very characteristic in form. It is interesting to note that the setæ of this species differ, both in size, form and waviness, from the setæ of *O. guatemalæ*, its most allied species. The setæ of *O. limicola* are perhaps the most characteristic of any, the general central swelling here having given place to two rounded swellings (fig. 78).

With our knowledge, extended through the discovery of new species, the following must be the diagnosis of the genus:

Ocnerodrilus Eisen.

Small oligochetes inhabiting soil, water, or both. Clitellum comprises the oviduct and the male pore.

Spermathecæ, with or without diverticula, present or wanting; in somite ix or viii, generally in ix. Spermathecal pores in front of inner couple of setæ.

No differentiated penial setæ; the inner pair in somite xvii either wanting entirely or wanting in one seta, or present. Nephridia paired, after the first few surrounded by a smaller or greater quantity of peritoneal cells.

Alimentary canal without gizzard and typhlosole, but with one pair of diverticula in somite ix. These diverticula connect with the œsophagus in the posterior part of the somite near the posterior septum. No subnervian vessel. One pair of hearts in somite x and one pair in xi. Sometimes a stout connecting vessel in somite ix. The ventral and dorsal vessels are, except in the somites, generally only connected in somites x and xi, and sometimes also in ix. One pair of lateral longitudinal vessels from the diverticula of the œsophagus. Testes in x and xi. One or two pairs of prostate glands (atria) in somites xvii and xviii opening in the same papilla as the sperm ducts. The epithelial lining of the prostate only one cell thick.

SYNOPTIC ARRANGEMENT OF THE SPECIES.

I. Spermatheca present in somite ix. Lower part of sperm duct not enlarged.

1. In the inner couple of setæ in somite xvii one seta is wanting. The lower part of the prostate not greatly differentiated.

a. The spermatheca large, club-like, with several distinct but rudimentary diverticula. The anterior septal gland is much larger than the one behind in somite vi. The prostate not exceedingly small. O. BEDDARDI.

b. The spermatheca is small, slightly indented, but otherwise with no distict diverticula. The anterior septal gland twice as long as the gland in somite vi. Prostate gland is unusually small. O. GUATEMALÆ.

c. Spermatheca very minute, without constrictions or trace of diverticula. The anterior septal gland only slightly larger than the one in somite vi. The prostate not unusually small.
O. SONORÆ.

2. The inner couple of setæ in somite xvii is wanting.

d. Spermatheca cylindrical, contracted, but with no diverticula. The septal gland in somite vii almost equal in size to the one in somite viii. One connecting vessel in somite ix. The prostate very small. O. HENDRIEI.

3. The inner couple of setæ in somite xvii is present. The lower part of the prostate is muscular and much differentiated from the upper glandular part.

e. One connecting vessel in somite ix. Spermatheca with a few wartlike and rudimentary diverticula. The septal gland in somite vii much larger than the one in somite viii.
O. LIMICOLA.

II. Spermatheca present in somite xi, with no diverticula. Lower part of the sperm duct with a large shuttle-like enlargement close to the male pore.

f. Spermatheça very large, globular, much wider than the œsophageal diverticulum. Sperm-sac in somite ix very large, lobed.
O. AGRICOLA.

g. Spermatheca long, cylindrical, not as wide as the width of the œsophageal diverticulum. Sperm-sac in somite ix very small, deeply lobed. O. ROSÆ.

h. Spermatheca medium, cylindrical, narrower than the width of the diverticulum of œsophagus. The sperm-sac in somite ix very large, not lobed. O. CONTRACTUS.

III. Spermatheca present in somite viii, with no diverticula. No enlargement of the lower part of the sperm duct.

i. Spermatheca sac like, with no diverticula. Sperm-sacs in ix and xii not lobed. O. EISENI.

IV. No spermatheca; no enlargement of the lower end of the sperm duct.

j. The septal glands in somites v, vi, vii and viii of nearly equal size. No sperm-sacs in ix, x, and xii, and those in xi very small. The inner couple of setæ in somite xvii present.
O. OCCIDENTALIS.

DIOGNOSES OF THE SPECIES.

Ocnerodrilus Beddardi, n. sp.

Clitellum xiii to xix. No ventral zone in xvii. One seta wanting in the inner pair in xvii. Spermathecæ, one pair in ix, club-like, medium size, small diverticula. Prostate short. The muscular part of the prostate is very short. The sperm ducts not enlarged before reaching the male pore. Large lobed sperm-sacs in ix and xii. No connecting vessel in somite ix. The septal gland in v largest. Sacculated intestine begins in xii.

Ocnerodrilus guatemalæ, n. sp.

Clitellum very short, xiv to xviii inclusive. No ventral zone. Spermatheca very short, sac or club-like, with a distinct lower muscular duct, with only a trace of diverticular swelling. The septal gland in somite v twice as large as the one in vi. Sacculated intestine begins in somite xii. No connecting vessel in somite ix.

Ocnerodrilus sonoræ, n. sp.

Clitellum very short in xiv to xvii. In the inner couple of setæ in somite xvii, the outer seta is missing. Spermatheca small, bag-like, no diverticula. Septal glands in v of almost the same same size as the one in vi, slightly larger. The lower part of the sperm duct is not enlarged. One pair of prostates in xvii; the lower or muscular part of each duct is not narrower than the glandular part. The large lobed sperm-sac in xii is the largest. Sacculated intestine begins in xii.

Ocnerodrilus Hendriei, n. sp.

Clitellum from xiv to xix, encroaching on xiii and xviii. The inner couple of setæ in xvii is wanting. Spermatheca small, cylindrical, no diverticula, about as long as the width of the diverticulum. Prostate short in two somites. Sperm-sacs in ix, xi, xii. The one in ix not much lobed. The one in xi very large, not lobed, and the one in xii much lobed. Sperm ducts without swelling. One pair of connecting vessels in somite ix. The septal gland in v much larger than the one in vi. The glands in vii and viii are very small. Sacculated intestine begins in xii.

Ocnerodrilus limicola, n. sp.

Clitellum, xiii to xix. No zone in xvii. The inner pair of setæ in somite xvii are wanting. Spermathecæ, small, cylindrical, with few, small, wart-like diverticula in somite ix. Prostate short. The sperm ducts not enlarged before reaching the male pore. Large lobed sperm-sacs present in ix and xii. One pair of connecting vessels between the dorsal and ventral vessels in somite ix. The septal gland in somite v is the longest. Sacculated intestine begins in xii.

Ocnerodrilus Eiseni, Beddard.

Clitellum in xiii to xix. The inner pair of setæ in xvii is wanting. Spermathecæ in viii, sack-like, medium, with no diverticula. Prostate long. Sperm ducts not enlared before reaching the male pore. Large lobed sperm-sacs in ix and xii. No connecting vessel in ix.

Ocnerodrilus Rosæ, n. sp.

Clitellum, xiii to xviii. The inner pair of the setæ in xvii is wanting. Spermathecæ, one pair in ix. Form long, cylindrical; no diverticula. Prostate very slender and long, with a long muscular part. Sperm ducts greatly enlarged close to the male pore. Sperm-sacs in ix, x, xi, xii. The one in ix is smaller than in other species, the one in xii not deeply lobed. No connecting vessel in ix. Septal glands not deeply lobed, almost entire. The one in v not, or hardly, larger than the one in somite vi. Sacculated intestine begins in somite xiii.

Ocnerodrilus contractus, n. sp.

Clitellum in xiii to xviii. The inner pair of the setæ in xvii is wanting. Spermatheca, as long as the diverticulum of the œsophagus is cylindrical, even in outline, with no diverticula. Sperm duct with a shuttle-like enlargement near the male pore, occupying about one and and one-half somite; its lumen about one-fourth or one-third as wide as the enlargement. Prostate with muscular duct. Septal gland in somite v not larger than the one in vi. Sperm-sac in somite ix very large, and longer than those in x, xi and xii. No connecting vessel in ix. Sacculated intestine begins in somite xii.

Ocnerodrilus agricola, n. sp.

Clitellum in xiv to xvii. A large ventral zone in somite xvii surrounding the male papilla. The inner pair of setæ in somite xvii wanting. Spermathecæ, one pair in ix, sack-like, globular, very large, with no diverticula. Prostate long. Sperm ducts enlarged before reaching the male pore. Large lobed sperm-sacs in ix and xii. No connecting vessel in ix. The septal gland in v is the largest. Sacculated intestine begins in xii.

Ocnerodrilus occidentalis, Eisen.

Clitellum, xiii to xix. No zone in xvii. One seta is wanting in the inner pair in somite xvii. No spermathecæ. Prostate very long. Sperm ducts not enlarged before reaching the male pore. No connecting vessel in ix. One pair of testes in x. No large lobed sperm-sacs in ix, x and xii. One pair sperm-sacs in xi, with muscular duct. The septal gland in v not longer than the one in vi, and the one in viii not smaller than the others. Sacculated intestine begins in xii.

The affinities of Ocnerodrilus have already been commented upon by Beddard, and he has pointed out the relationship of our worm with Pontodrilus, Photodrilus, Microscolex and Gordiodrilus. The latter genus he places in the same family as Ocnerodrilus, and retains the name of Ocnerodrilidæ.

In this I cannot exactly agree. It is, however, entirely too early to successfully generalize as regards the relationship of these worms, as it is evident that a whole class of worms must exist which forms connecting links between the land and water Oligochætæ, and of which class so far only very few genera are known. They have escaped the casual collectors by their minuteness, while the students of this class of worms have had only little opportunity to collect in tropical countries. When these minute Oligochætæ have become better known we will be able to generalize without running the risk that the next investigator will, with equal propriety, upset all our views. While Gordiodrilus in many respects greatly resembles Ocnerodrilus, it appears to me that it differs too much and in too many important points to be placed in the same family. As Benham remarks, the affinities of both genera are greatest with many genera of the large family of Cryptodrilidæ, least of all perhaps with Cryptodrilus.

From Gordiodrilus our genus differs principally in having salivary pharyngeal glands. Gordiodrilus has none. Also in having a pair of œsophageal pouches, while Gordiodrilus has only one. This latter is very differently constructed from the pouches in Ocnerodrilus. In Gordiodrilus the prostate and the sperm duct open in different pores, similarly as in Acanthodrilidæ, while in Ocnerodrilus the prostate and sperm duct open in the same pore. In Ocnerodrilus the male pore is invariably found in somite xvii, while in Gordiodrilus it opens in somite xviii. The prostates in this genus vary considerably, in one species opening in somites xvii and xviii (*G. robustus*), in another in xviii and xix (*G. elegans*), and in another in xx and xxi (*G. tenuis*).

The following comparative table will show the differences and similarities of the two genera:

	Ocnerodrilus.	*Gordiodrilus.*
Setæ.	Paired, of usual lumbricid pattern.	Same.
Clitellum.	Variable, always including the male papillæ.	Same.
Nephridia.	Paired, after the first few surrounded by a smaller or greater mass of peritoneal cells.	Same.
Alimentary.	No gizzard.	Gizzard generally, but not always absent.
	No typhlosole.	Same.
	One pair of diverticula of the œsophagus in somite ix.	One single diverticulum of the œsophagus.
	Only longitudinal parallel bloodvessels in the diverticulum.	Longitudinal and transverse bloodvessels in the diverticulum.
Testes.	In x and xi, or only in x.	Same.
Vessels.	No subnervian vessel.	Same.
	Two pair of large hearts in x and xi.	Same.
	One or two pair of prostate glands opening in xvii (and xviii).	One or two pair of prostate glands opening in two consecutive somites, in xvii, xviii, xix, xx or xxi.
	Sperm ducts open in the same pore as the prostate.	Sperm ducts open independently of the prostate, and in the same somite as one of the prostates, but not in the same pore.
Ovaries.	In xiii.	Same.
Spermathecæ.	One pair, or none, in viii or ix, generally in ix. Diverticula rudimentary or absent.	Two pair or one pair, in vii, viii. Diverticula rudimentary or absent.
Spermiducal pore. (Vas deferens)	Always in xvii.	In xviii.

Considering these differences, I propose to place Gordiodrilus in a family of its own, *Gordiodrilidæ*, which might be characterized as follows (the description being after Beddard):

Gordiodrilidæ.

Small slender terrestrial oligochætæ, with paired setæ of the usual lumbricid pattern. Clitellum includes the male pore. Nephridia paired, after the first few surrounded by peritoneal cells. No pharyngeal or salivary glands. Large septal glands investing the œsophagus in somites v to vii. No typhlosole. *Œsophagus with a single median ventral diverticulum.* No subnervian vessel. Two pairs of hearts in x and xi. Testes in x (and xi). *Prostates opening independently of the sperm ducts. Spermiducal pore in xviii.* Ovaries in xiii. Ovi ducal pore in xiv. Spermathecæ variable, in vii or viii, or absent, with no or rudimentary diverticula. No penial setæ, no subnervian vessel, and no blood vessels on the nephridia.

Ocnerodrilidæ.

Small slender terrestrial oligochætæ, with paired setæ of the usual lumbricid pattern. Clitellum includes the male pore. Nephridia paired, the first row with no peritoneal cells, the posterior nephridia with more or less peritoneal cells. Large pharyngeal or salivary glands. Large septal glands investing the œsophagus in v to viii. No typhlosole. *Œsophagus with one pair of lateral pouches or diverticula* in somite ix, through which pass a pair of large lateral vascular trunks. No subnervian vessel. Two pair of hearts in x and xi (and sometimes a third, smaller, in xi). Testes in x and xi. *Sperm ducts always opening in the same pore as a large prostate in xvii.* Sometimes an additional prostate opening independently in xviii. Ovaries in xiii. Oviducal pore in xiv. Spermathecæ, one pair or none in viii or ix, with no or rudimentary diverticula. No penial setæ and no subnervian vessel. No blood vessels on the nephridia.

Among other genera which Ocnerodrilus resembles, Pygmæodrilus appears rather prominently. I will here only call the attention to the long prostates which are differentiated into a muscular and a glandular part, and which extend through many somites, just as in Ocnerodrilus and Gordiodrilus. The swelling or muscular enlargement possessed by some species of Ocnerodrilus resembles greatly that of Pygmæodrilus. The greatest difference between that and our genus is the arrangement of the ciliated rosettes which in Pygmæodrilus are invested by the sperm-sacs, while in both Ocnerodrilus and Gordiodrilus they open independently. The paired diverticulum of the œsophagus is also found in Pygmæodrilus.

Of all the various characters in which Ocnerodrilus and Gordiodrilus resemble each other and in which they also differ from the genera of Beddard's Cryptodrilidæ, the absence of bloodvessels on the nephridia and the single cell structure of the glandular part of the atrium are the two most important ones. The character derived from the presence or absence of diverticula on the spermatheca is weaked by the fact that the diverticula of this organ vary greatly in size, or are entirely absent in some species of the same genus. The absence of a gizzard is of late consigned to a mere species character (by Beddard), and the form and arrangement of the setæ can in no way be considered of equal value to the arrangement of the inner organs. The presence of septal glands in our two genera is also of great importance, as connecting them with lower forms. The safest we can say at present is, that Ocnerodrilus and Gordiodrilus are connecting links which, through their relationship with Pontodrilus, Photodrilus, Microscolex and Pygmæodrilus, connect the limicolid oligochætæ with the higher terrestrial forms.

I append some diagrams to show the arrangement of the several organs, etc., in the genera, which may be best compared with Ocnerodrilus. Some of these diagrams are borrowed from Benham's admirable paper (An Attempt to Classify Earth Worms). The diagram of Gordiodrilus has been compiled from Beddard's paper on this genus.

PAPERS REFERRED TO.

FRANK E. BEDDARD. On the Anatomy of Ocnerodrilus. Proceedings Royal Society of Edinburgh. Vol. 36, pages 563 to 583.

FRANK E. BEDDARD. On a New Genus of Oligochætæ, Comprising Five New Species Belonging to the Family Ocnerodrilidæ. Annals and Magazine of Natural History, No. 55, July, 1892, page 74, plates vi and vii.

FRANK E. BEDDARD. Abstract of some Investigations into the Structure of the Oligochæta. Annals and Magazine of Natural History, Jan., 1891, p. 88.

DANIELE ROSA. Sui genere Pontodrilus, Microscolex and Photodrilus. Bollettino dei Musei di Zoologia, Universita di Torino, vol. iii, No. 39, Marzo, 1888.

W. B. BENHAM. An Attempt to Classify Earth-worms, Quatr. Journal of Microscopical Science, vol. xxxi, part ii, p. 201.

TABLE OF SPECIES OF OCNERODRILUS.

Ocnerodrilus	*Beddardi* n. sp.	*guatemalæ* n. sp.	*sonoræ* n. sp.	*Hendriei* n. sp.	*limicola* n. sp.	*Eiseni* Beddard.	*Rosæ* n. sp.	*contractus* n. sp.	*agricola* n. sp.	*occidentalis* Eisen.
Clitellum in somites	xiii to xix. No ventral zone	xiv to xviii. No zone.	xiv to xvii. No zone.	½xiii to ½xviii, or xiv to xvii. No ventral zone.	xiii to xix. No ventral zone.	xiii to xix. No ventral zone.	xiii to xviii. No ventral zone in xvii, one in xviii.	xiii to xviii. No ventral zone.	xiv to xvii. Ventral zone around male papilla in xvii.	xiii to xix. No ventral zone.
Inner couple of *setæ* in somite xvii:	The inner seta is wanting.	The outer seta is wanting.	The outer seta is wanting.	Both setæ wanting.	Both setæ present.	Both setæ wanting.	Both setæ wanting.	Both setæ wanting.	Both setæ wanting.	Both setæ present.
Spermatheca:	Medium size, club-like, with rudimentary diverticula. In somite ix.	Very small, no diverticula. In somite ix.	Very small, bag-like; no diverticula. In somite ix.	Small, cylindrical. No diverticula. In somite ix.	Small, cylindrical, a few wart-like diverticula. In somite ix.	Medium, sac-like; no diverticula. In somite viii.	Long, cylindrical; no diverticula. In somite ix.	Medium, cylindrical; no diverticula. In somite ix.	Very large, globular; no diverticula. In somite ix.	No spermatheca.
Septal glands: The one in somite v is:	Larger than the one in vi.	Very much larger than the one in somite vi; all deeply lobed.	Of almost the same size as the one in somite vi, slightly larger.	Much larger than the one in vi.	Larger than the one in vi.		Not larger than the one in vi.	Not larger, but smaller than the one in vi.	Larger than the one in vi.	Not larger than the one in vi.
Lower part of *sperm duct* in somites xvi and xvii:	Not enlarged.	Not enlarged.	Not enlarged.	Not enlarged.	Not enlarged.	Not enlarged.	Much enlarged; lumen narrow.	Much enlarged; lumen wide.	Much enlarged.	Not enlarged.
Prostate:	One pair in somite xvii.	One pair; very minute and slender; confined to one somite, xvii.	One pair in somite xvii.	One pair in somite xvii, very minute.	Two pair, in somites xvii and xviii.	One pair in somite xvii.	One pair in somite xvii.	One pair in somite xvii.	One pair in somite xvii.	One pair in somite xvii.
Large lobed sperm-sacs in ix and xii	Present.	Present, the one in somite xii not larger than the one in somite ix.	Present. The one in somite xii very much larger than the other.	Present; in ix slightly lobed in xii much lobed.	Present, both deeply lobed.	Present, but not lobed.	Present, but not as deeply lobed as in *limicola*.	The one in ix not lobed, the one in xii much lobed.	Present, both deeply lobed.	None.
Sacculated intestine commences in	xii.	xii.	xii.	xii.	xii.	xii.	xiii.	xii.	xii.	xii.
Connecting vessel in somite ix between v. v. and d. v.	None.	None.	None.	One pair.	One pair.	None.	None.	None.	None.	None.

EXPLANATION OF THE FIGURES.

Plate V.

Ocnerodrilus Beddardi, fig. 1 to 15.

Fig. 1. Collective view of the various organs in the anterior part of the body, showing their general form and location. This view is semi-schematic.

pr. st. prostomium.

phx. pharynx.

s. ph. gl. supra-pharyngeal ganglion.

s. gl. septal glands in somites v, vi, vii, viii.

t. testes in x and xi.

s. s. sperm-sacs.

ss. l. lobed sperm-sacs.

spth. spermatheca.

c. r. ciliated rosettes in somites x, xi.

clt. clitellum.

ov. ovary.

od. oviduct.

op. ovipore.

♂. male papilla.

pr. prostate gland or atrium.

s. i. sacculated intestine.

sp. d. Sperm ducts.

v. v. ventral longitudinal vessel.

d. v. main longitudinal dorsal vessel.

s. d. v. secondary dorsal vessel.

s. v. v. secondary ventral vessel.

l. v. lateral vessel from the diverticulum.

œs. œsophagus.

dvt. diverticulum between œsophagus and tubular intestine.

h. hearts.

clt. clitellum.

ms. muscles connecting the glands with the parietes of the somites.

nph. nephridia. In this figure the nephridia have been left out in order not to crowd the lines.

sp. septa.

sl. gl. salivary glands.

i to xx. the roman numerals indicate the number of the somites, counting the prostomium and the peristomium as the first somite (i).

Fig. 2. Section of the seven anterior somites, showing the pharynx and pharyngeal glands. The letters indicate the same as in the previous figure.

Fig. 3. One of the testes in somite xi.

Fig. 4. One of the testes in somite x.

Fig. 5. A body of peritoneal cells of one of the posterior nephridia.

Fig. 6. Part of a septal gland.

Fig. 7. Part of a salivary pharyngeal gland.

Fig. 8. Transverse section of the clitellum.

Fig. 9. Perigastric cells, massed and single.

Fig. 10. Lower part of one of the posterior nephridia.

i. s. g. inter-segmental groove.

nph. pr. nephridio pore.

pr. c. peritoneal cells.

Fig. 11. Anterior part of the œsophageal diverticulum, showing the beginning of the lateral collective vessel. Exterior view.

drt. exterior of diverticulum.

cl. v. collective vessel.

Fig. 12. Longitudinal section of the anterior part of the diverticulum, showing the lacunary system.

ep. l. inner epithelial lining.

i. l. interior lacunary system.

tb. tube supposed to be joined to *i. l.*

cl. v. collective vessel.

Fig. 13. A more highly magnified part of the former.

ep. l. epithelial lining.

v. bloodvessels.

PLATE VI.

Fig. 14. Nephridium of one of the posterior somites. The peritoneal cells in the upper part of the nephridium are not indicated, the general outline only being shown.

Fig. 15. *O. occidentalis.* Testis from somite x.

Fig. 16. *O. occidentalis.* Sperm-sac with duct from somite xi.

s. septum.

Fig. 17. *O. Beddardi.* Oviduct.

Fig. 18. *O. Beddardi.* Sperm duct.

c. r. ciliated rosette.

t. testis.

h. heart; all from somite x.

Fig. 19. *O. Beddardi.* A celloidine section of the diverticulum of the œsophagus in somite ix. The central streamers at *a* and *c* are parts of the diverticulum wall and not any interior partitions,

these walls being raised in such a way as to be cut through in an eccentric section.

v. vessels of the pouch, collecting in the longitudinal vessel, *c. l.*

i. l. interior lacunary system.

œs. œsophagus and tubular intestine.

Fig. 20. *O. Beddardi.* The semi-parallel vessels of the œsophageal diverticulum.

œs. v. œsophageal vessel.

cl. v. collecting vessel.

Fig. 21. *O. occidentalis.* Ovary and oviduct in somites xiii and xiv.

ov. ovary.

od. oviduct.

s. septa.

Fig. 22. *O. occidentalis.* Septal gland of somite vi.

œs. œsophagus.

ms. muscular bands.

Fig. 23. *O. Rosæ.* A collective and semi-schematic view of the anterior part of the body in longitudinal section.

s. ph. gl. supra-pharyngeal ganglion,

sl. gl. salivary glands of the pharynx.

s. gl. septal glands in somites v, vi, vii and viii.

s. septa.

spth. spermatheca.

ss. l. lobed sperm-sacs in somites ix and xii.

s. s. sperm-sacs in somites x and xi.

s. i. sacculated intestine, beginning in somite xiii.

cl. clitellum.

d. v. dorsal vessel.

v. v. ventral vessel.

dvt. diverticulum of the œsophagus in somite ix.

t. testes.

c. r. ciliated rosettes.

ov. ovary.

od. oviduct.

sp. d. the widened or muscular part of the sperm duct.

♂. male papilla.

m. pr. muscular part of the prostate gland.

gl. pr. glandular part of the prostate gland.

Fig. 24. *O. Rosæ.* Male papilla with sperm duct and prostate gland in somite xvii.

m. pr. muscular part of the prostate gland.

gl. pr. glandular part of the prostate gland.

m. sp. d. muscular part of the sperm duct.

sp. sperm duct.

Fig. 25. *O. Rosæ.* A part of the muscular portion of the prostate gland showing glandular cells imbedded in and between the spiral muscles.

gl. glands.

l. inner lumen of the duct, the focus being set on the surface of the duct.

ms. spiral muscles.

Fig. 26. *O. Rosæ* A portion of the upper surface of the glandular part of the prostate gland, showing the ends of the tubular cells.

PLATE VII.

Fig. 27. *O. Beddardi.* A spermatheca from somite ix.

d. rudimentary diverticula; a portion of the tubular cells are shown. They are more regular and prominent than in any other species.

b. w. body wall.

Fig. 28. *O. Beddardi.* The other side of the same spermatheca.

d. rudimentary diverticula.

ms. muscular lower part of the organ.

Fig. 29. *O. Beddardi.* Section of the wall of one of the spermathecal diverticula shown in the last figure.

spz. spermatozoa.

Fig. 30. *O. Beddardi*, a semi-schematic view of the lateral vessels in one of the posterior somites.

d. v. dorsal longitudinal pulsating vessel.

v. v. ventral longitudinal non-pulsating vessel.

l. d. v. lateral dorsal vessel, two of which are found in each somite.

l. v. v. lateral ventral vessel, two of which are found in each somite. Both of these two vessels cling principally to the parietes of the somite.

g. v. gastric vessel, one pair of which are found in each somite, they spread on the sacculated intestine, feeding the gastric system.

v. gl. ventral nerve ganglion.

s. septa.

s. i. sacculated intestine. The upper and lower line indicate the parietes of the body somites.

Fig. 31. *O. limicola.* A semi-schematic view of the pharynx, œsophagus, septal glands, dorsal vessel and hearts, showing the relative size of the septal glands and their lobes. Also the connecting vessel in somite ix.

phx. pharynx.

sl. gl. salivary glands.

s. septa.

s. gl. septal glands.

dvt. diverticulum of the œsophagus.

c. v. connecting vessel in somite ix between the dorsal and ventral vessel.

h. hearts in somites x and xi.

s. i. sacculated intestine.

Fig. 32. *O. Beddardi.* Sperm-sac in somite xii.

Fig. 33. *O. Beddardi.* Part of a lobe showing spermatozoa.

Fig. 34. *O. agricola.* The anterior part of the intestine shown in outline.

Fig. 35. *O. limicola.* The spermatheca.

Fig. 36. *O. Rosæ.* The spermatheca.

Fig. 37. *O. Beddardi.* The upper lobe of the septal gland in somite v, and the muscular band around which it is arranged.

Fig. 38. *O. Hendriei.* The anterior somites, longitudinal or side view, showing the relative proportions of the septal glands, sperm-sacs, etc.

sl. gl. salivary glands of the pharynx.

s. septa.

l. v. lateral longitudinal vessel.

spth. spermatheca and spermathecal pore.

dvt. diverticulum of the œsophagus.

s. s. sperm-sacs.

ss. l. lobed sperm-sac in somite xii.

h. hearts in somites x and xi.

c. v. connecting vessel in somite ix.

s. i. sacculated intestine.

d. v. dorsal vessel.

v. v. ventral vessel.

Fig. 39. *O. Hendriei.* Spermatheca.

Fig. 40. *O. Beddardi.* Supra-pharyngeal ganglion, the commissures and the ventral nerve trunk and their branches.

Fig. 41. *O. agricola.* The globular spermatheca.

Fig. 42. *O. contractus.* Side view of the anterior somites, showing the relative proportions of the septal glands, spermatheca, sperm-sacs, etc.

sl. gl. salivary gland of the pharynx.

s. septa.

dvt. diverticulum of œsophagus.

spth. spermatheca.

s. s. sperm-sac in somite ix, x and xi.

ss. l. lobed sperm-sac in somite xii.

Fig. 43. *O. contractus.* Spermatheca from the right hand side of somite ix.

Fig. 43*b*. *O. contractus.* Spermatheca from the left side of somite ix; same individual as last, showing the slight variation in size and form.

Fig. 44. *O. agricola.* Ventral view of the clitellum and male pores.

Fig. 45. *O. contractus.* Distal end of spermatheca more magnified.

PLATE VIII.

Fig. 46. *O. agricola.* The prostate gland and the enlargement of the sperm duct. Only a part of the prostate is shown; the beginning of the glandular part is in somite xviii and the end in somite xxvi.

Fig. 47. *O. limicola.* The two prostates in somites xvii and xviii.

Fig. 48. *O. Rosæ.* The prostate and the enlarged sperm duct in somite xvii.

Fig. 49. *O. Beddardi.* The prostate and the sperm duct somite xvii.

Fig. 50. *O. contractus.* The prostate and sperm ducts in somite xvii.

pr. prostate.

sp. d. sperm duct.

v. g. ventral ganglion.

ms. muscular band confining the lower parts of the sperm ducts and the prostates to the parietes of the somites.

Fig. 51. *O. contractus.* The lower part of the prostate and the enlarged sperm duct, showing the relative size of the lumen in the latter.

Fig. 52. *O. contractus.* The ovary and oviduct in somites xiii and xiv.

Fig. 53. *O. limicola.* One of the prostates and part of the sperm duct in somite xvii.

Fig. 54. *O. agricola.* Side view of somites iv to xii.

s. s. sperm-sacs.

ss. l. lobed sperm-sacs.

h. hearts.

s. septa.

sl. g. salivary glands.

sp. gl. septal glands in v, vi, vii and viii.

spth. spermatheca.

drt. diverticulum of the œsophagus.

t. testes.

œ. œsophagus.

s. i. sacculated intestine in xii.

Fig. 55. *O. Beddardi.* The prostate and part of sperm duct.

st. inner seta in somite xvii.

c. p. copulatory papilla.

b. w. body wall.

sp. d. sperm duct.

pr. prostate.

Fig, 56. *O Beddardi:* The lower part of the prostate showing the muscular part.

Fig. 57. *O. sonoræ.* Part of the sperm duct close to the male pore.

Fig. 58. *O. sonoræ.* Part of the muscular part of the prostate.
Fig. 59. *O. sonoræ.* The prostate and part of sperm duct.
Fig. 60. *O. sonoræ.* Spermatheca.

PLATE IX.

Fig. 61. *O. guatemalæ.* Side view of the anterior somites. The parts of the septal glands covering the œsophagus are not represented.
sl. gl. salivary glands of the pharynx.
s. gl. septal glands.
s. septa.
s. s. sperm-sacs.
dvt. diverticulum of the œsophagus.
œs. œsophagus.
s. i. sacculated intestine.
ov. ovary.
ovd. oviduct.
spth. spermatheca.
d. v. dorsal vessel.
v. v. ventral vessel.
h. hearts.
t. testes.
Fig. 62. *O. guatemalæ.* Spermatheca.
Fig. 63. *O. guatemalæ.* Spermatheca, a smaller form.
Fig. 64. *O. guatemalæ.* Free end of spermatheca more enlarged.
Fig. 65. *O. guatemalæ.* Somite xvii, showing the prostates.
Fig. 66. *O. guatemalæ.* One of the prostates more enlarged.
Fig. 67. *O. contractus.* One of the male papillæ in somite xvii.
Fig. 68. *O. occidentalis.* The male papilla and the inner couple of setæ in somite xvii.
Fig. 69. *O. occidentalis.* The prostates and part of the sperm ducts.
sp. d. sperm ducts.
m. pr. muscular part of the prostate.
gl. pr. glandular part of prostate.
v. gl. ventral ganglion.
Fig. 70. *O. occidentalis.* The anterior somite, side view. In this, as in nearly all the side view figures where the septal glands are shown, only a part of the glands are represented in order to show the œsophagus. In all the species the septal glands surround the œsophagus completely and hide it from view.
sl. gl. salivary glands of the pharynx.
s. gl. septal glands of somites v to viii.
dvt. diverticulum of the œsophagus.
s. s. sperm-sacs.
o. ovary.
ovd. oviduct.

t. testes.

c. r. ciliated rosettes.

h. hearts.

s. i. sacculated intestine.

œs. œsophagus.

s. septa.

d. v. dorsal vessel.

v. v. ventral vessel.

Fig. 71. *O. sonoræ.* The anterior somites, side view. Letters indicate the same as preceding figure.

Fig. 72. *O. Hendriei.* The male pore.

Fig. 73. *O. sonoræ.* The male pore.

a. side view.

b. front view.

Figs. 74 to 82. Setæ of the various species of Ocnerodrilus described in this paper. The figures have all been drawn to the same scale, with camera, and represent the relative size of the seta in the various species. The drawing was made of one of the inner couples immediately behind the clitellum.

Fig. 74. Seta of *O. Beddardi.*

Fig. 75. Seta of *O. sonoræ.*

Fig. 76. Seta of *O. guatemalæ.*

Fig. 77. Seta of *O. Hendriei.*

Fig. 78. Seta of *O. limicola.*

Fig. 79. Seta of *O. Rosæ.*

Fig. 80. Seta of *O. contractus.*

Fig. 81. Seta of *O. agricola.*

Fig. 82. Seta of *O. occidentalis.*

Fig. 83. *O. Hendriei.* The prostate.

pr. prostate.

sp. d. sperm duct.

v. gl. ventral ganglion.

Fig. 84. The œsophageal diverticulum of *O. occidentalis.*

Fig. 85. The œsophageal diverticulum of *O. sonoræ.*

Plate X.

Figs. 86 to 91. Diagram of the organs of various genera showing relationship with Ocnerodrilus.

Fig. 86. *Ocnerodrilus.*

Fig. 87. *Gordiodrilus.*

Fig. 88. *Pontodrilus.*

Fig. 89. *Photodrilus* (after Benham).

Fig. 90. *Microscolex* (after Benham).

Fig. 91. *Pygmæodrilus* (after Benham).

ON THE ANATOMICAL STRUCTURES OF TWO SPECIES OF KERRIA.

BY GUSTAV EISEN.

While my late paper on new species of Ocnerodrilus* was passing through the press I found that a tube which I had supposed to contain specimens of *Ocnerodrilus Beddardi*, really housed an entirely different form. It was too late to add anything to my previous paper, and I had to reserve detailed account to a later date. A closer examination of this oligochætous worm proved that not only had I before me a new species, but a different genus of unusual interest especially at this time when our knowledge of the systematic arrangement of the oligochæta is constantly increased by finding extreme as well as intermediate forms.

The MS. describing these worms as a new genus was already in print, when I received Beddard's paper on Kerria, a new genus, intermediate between Acanthodrilus and Ocnerodrilus. I recognized at once that my new forms did not differ sufficiently to warrant a new genus to be formed. The genus Kerria was founded by Beddard on a worm from Pilcomayo, the genus is therefor an American one, and we may expect to find it to contain as many species as Ocnerodrilus.

The discovery of this form was quite unexpected. The locality where found is the so-called Cape Region of Baja California, the extreme southern part of the peninsula, not very far from San José del Cabo. The exact locality is a swampy or rather shallow pond, surrounded by tall palm trees *(Pritchardia Sonoræ)*, situated immediately south of the village Miraflores on the road to San José del Cabo, in the very outskirts of that

* *ante*, p. 228.

village. The bottom of the pond consists of a black sticky mud which is at the edges of the pond interwoven with projecting palm-root fibers. Among these in the mud the worm was found. Unfortunately I had only a few minutes to spend in collecting and the worm being scarce I found only a dozen specimens in all, most of which were immature. This was in March of last year. In size and form the worm greatly resembles *Ocnerodrilus Beddardi*, though when it was alive there must have been some distinguishing features, as my notes made at the time of discovery read: "Differs in general appearance from the common Ocnerodrilus of the region being perhaps a little thicker in front and also a little flatter."

The occurence and distribution of these minute oligochæta are frequenly restricted and unaccountable. In the San José del Cabo Region I found generally in every moist place only *Ocnerodrilus Beddardi* and no other form. In this pond, situated in the center of that region, a new genus suddenly looms up, and is found nowhere else in that vicinity.

With species of Ocnerodrilus the same limited distribution is noticeable. Thus the only California species of this genus is *Ocnerodrilus occidentalis* which to date has only been found in a single garden, one hundred feet square, and strange to say five years previous to the first finding of this species, the locality in question was in the midst of a desert with not a drop of permanent water within twenty miles. It is reasonable to suppose that the worms were brought down by irrigation water, but though I searched repeatedly along the source of the water supply and along the canals I could not find them outside of the original locality. These instances could readily be multiplied. Some species have a wide distribution, others are confined to certain ponds and marshes or even to certain spots in these ponds. Some ponds contain absolutely no oligochæta of interest, others swarm with common forms, others again may contain a few endemic species for which we search in vain somewhere else. Around San Francisco each one of the few ponds in the region contain endemic forms, while other species are common in them all. I found the same to be the case in Mexico and Central America as well as in the Sierra Nevada of California where, even in the high mountains where water in the form of springs, creeks and rivers form a perfect system and is found everywhere, most interesting forms of oligochæta are restricted to certain springs or swamps. The cause may possibly be laid to the differences in the quality of the water, which though slight may be sufficient to prevent a wider and more general distribution of species.

Kerria Beddard, 1892.

Minute fresh water oligochæta related to Ocnerodrilus and Gordiodrilus. Spermathecal pores between somites vii and viii and viii and ix. Spermiducal pore in xviii. Oviduct in xiii. Oviducal pore in xiv. One pair of diverticula of the œsophagus in ix containing parallel blood vessels which do not anastomose. Salivary glands on the pharynx. Septal glands surrounding the œsophagus in somites v, vi, vii and viii. The posterior nephidia covered with large peritoneal cells. No blood vessels on the nephridia. The ventral and dorsal vessel connected by two pair of hearts in somites x and xi. No other connecting vessels. The prostates open in somites xvii and xix. The sperm duct opening independently in somite xviii. The prostates and sperm duct open on two crescent-shaped zones, one on each side of the ventral ganglion in somites xvii, xviii and xix, and which covers the ventral couple of setæ. Testes in x. Sperm-sacs present. Clitellum covers the male zone, but is not developed ventrally. Setæ are sigmoid, eight on every somite in couples of twos.

Kerria McDonaldi *n. sp.*

Figs. 1–11, 12–19, 21–27.

The size of the worm is about one inch by 1 line, the anterior part of the body is considerably thickened as far as to somite ix, the following somites, towards the clitellum are much narrower. Clitellum covers somites xiv to xx. Four septal glands in somites v, vi, vii and viii, the anterior of which is the largest, the posterior one the smallest. No gizzard. Sacculated intestine commences in somite xii. Spermathecæ two pairs, one pair in somite viii and one in ix, with diverticula when fully developed. Testes one pair in x, connecting with the sperm-sacs in the same somite. There are one pair of sperm-sacs in x, one pair in xi and sometimes a very minute one in xii. Ciliated rosettes in x. Sperm duct opens independently of the prostates in xviii in an independent pore. The sperm duct is cylindrical, of even width throughout with no enlargements. Two pair of prostates, each prostate opening in an independent porus. The prostates are short, about as long as the worm is wide, much bent and twisted, of varying length and of somewhat varying shape. There are a muscular and glandular part, the latter consisting of a single row of glandulous cells.

Setæ are sigmoid, those of the inner or genital couples in somites xvii to xix are about ⅓ smaller than all other setæ, this referring to those in the same somites as well as to those in other somites. All the setæ in the genital zone are present. The posterior nephridia are thickly covered with peritoneal cells, and are very large, filling the somite.

Habitat. In mud at Miraflores near San José del Cabo, Cape Region of Baja, California. Species named in compliment to James M. McDonald of San Francisco.

The *body* offers little that is characteristic. In outward form it resembles more Gordiodrilus than Ocnerodrilus, judging from the figures given by Beddard, though there can be but little outward difference between the two genera. The prostomium and peristomium are quite large, wider than any of the following three somites (ii to iv), which are quite narrow. Somites v to ix are much wider, and somites v, vi and vii are also much higher than any of the others, those of the clitellum not excepted. From somite viii the body narrows gradually down to the clitellum which is only slightly wider and not equal in width to the thicker anterior part of the body, occupied by somites vi to viii.

The *clitellum* covers somites xiii to xx and is developed only superiorly and laterally, just as in Ocnerodrilus. The posterior part of the body tapers gradually towards the tail end which is narrower than in Ocnerodrilus. In alcoholic specimens the body is always strongly bent at somites x and xi, the clitellum being often included in the bend. This bend makes longitudinal sectioning difficult, or at least unsatisfactory, the genital papillæ being always folded or distorted, the more so as the bend is always toward the ventral zone. All Ocnerodrilidæ bend when placed in alcohol, but none to the same extent as this Kerria. The body-wall of the anterior somites is thicker than in Ocnerodrilus. This is especially the case with the ventral region of somites ii to ix; the dorsal region of these somites is also thick but less so than the ventral one. Somites x, xi and xii are very thin walled and it is probably this which causes the body to bend. The upper part of the clitellum is much thickened and of the same general structure as in Ocnerodrilus. The lower part of the clitellum is gradually thinned out toward the genital zone, below which and the ventral line the body-wall is not differentiated.

Genital zone (figs. 3 and 23). As has been already stated the male pore as well as the prostate pores open on an elevated zone not unlike that one described by Beddard in Gordiodrilus, only the zone is paired, there being one on either side of the median line. Between the two zones there is a cylindrical cavity of even width running exactly below the ventral ganglion and across somites xvii, xviii and xix. There are no papillæ in this cavity, nor is there any connection between it and the genital zone. But in each of the three somites, covered by the cavity, there is a transversal muscle which stretches across it and which contracts the body in such a way as to bring the genital zones closer together, which again gives rise to the tubular cavity. The genital zone on either side is crescent-shaped, the convex part of the crescent being toward the ventral median line of the body, that is, the points of the crescent are turned away from the ventral ganglion. The anterior and prosterior part of the zone ends each in an oblong papilla thicker at the point furthest away from the ventral nerve ganglion. The center of the convex side of the crescent is furnished with a large oblong papilla, which does not extend across the crescent to its concave side. In the center of this papilla on the margin of the crescent is situated the pore of the sperm duct. In the anterior papilla opens the pore of the anterior prostate, while in the posterior papilla opens the posterior prostate. In the center of the genital zone is a semicrescent-shaped depression, which however does not connect with the interior of the body. In examining the inner or outer surface of the zone this depression appears transparent, compared to the thick and dark edgings of the zone. The segmentations of the somites end prominently on the genital zone and the edges are furnished with perforated papillæ of very minute size, and with a few epidermal appendages almost as wide as the body-wall. The inner setæ of the inner couple are fairly outside of the genital zone, while the outer setæ of the same couple are entirely in the zone and situated very close to the prostate and male pore. In *Kerria McDonaldi* the setæ are all present, while in *Kerria zonalis* the outer setæ in the inner couples of somites xvii and xix are wanting. In Ocnerodrilus no similar zone is found. The nearest approach to one is seen in *Ocnerodrilus limicola*, in which species the clitellum projects down to the male pore in somite xvii. In Gordiodrilus the zone, according to Beddard, is median and ventral, there being only one transparent depression between the genital papillæ, on the edge of which the four prostates as well as the two male pores are opening. The single genital zone must then correspond to the two zones and to the tubular groove between them in Kerria. In fact in Gordiodrilus the two zones and tubular cavity of Kerria must have been fused into one single zone.

The epidermal lining of the central papilla of the genital zone is furnished with a small number of paddle-like appendages, in reality probably only parts of the zonal hypodermis which through ultra development have become separated from the papilla. They are quite small and their structure is not quite plain, with an interior cellular network. In size they are as long as the body-wall is wide and they vary in number.

Septa (figs. 1 *a.*, 2 *s.*). The septa exhibit the same general features as those in Ocnerodrilus and Gordiodrilus. The first anterior septum is found between somites iv and v and is thin and imperfect. The posterior parts of the pharynx and buccal region rest against this septum, only when the body is contracted, otherwise there is a short œsophageal part in this somite, which in an extended worm intervenes between the pharynx and the septum.

The four septa posterior to this one, that is those between somites iv, v, vi, vii, viii, are much thickened, but not to the same degree. The septum between v and vi, is thinner than the other three, about twice as thick as the septum between iv and v. The other three septa are of almost the same thickness and about three times as thick as the one between iv and v.

As usual the septa are thickest in the center, thinning out towards the junction with the body-wall. The septa following these are of the usual thinness, those anterior of the clitellum being thicker than those in the clitellum or posterior to it.

Alimentary canal (figs. 1, 2, 18 and 19). The alimentary system resembles that of Ocnerodrilus with few less important exceptions. As usual we can distinguish the following distinct regions: buccal cavity, pharynx, œsophagus, diverticula, tubular intestine and sacculated intestine.

The *buccal cavity* extends almost to the posterior part of somite iv, and is eversible. Its walls are much thicker than in any species of Ocnerodrilus which has come to my notice, especially so in the posterior ventral side of somite iv.

The *pharnyx* occupies somites ii, iii and part of iv, and is developed only on the upper side. It is much smaller than in Ocnerodrilus and when contracted forms only one single fold, instead of three and four as in Ocnerodrilus. The walls are as thick as in that genus, and the inner epithelial lining is strongly ciliated. The upper part of the pharnyx is covered with a dense mass of muscular bands.

Salivary or pharyngeal glands (figs. 1 and 2). To about two-thirds of their length these muscles are thickly coated with salivary glands of similar nature as those found in Ocnerodrilus, though the whole mass appears more compact and regular in outline than in the latter genus. Seen in a longitudinal section there appears to be only two distinct bodies of pharyngeal glands, one posterior and one anterior, both confined to somite iv. The two glandular masses are of almost equal size, and are very much rounded superiorly. The posterior mass exhibits several distinct lobes, no one of which, however, projects much further backward than the other. Seen from above the glandular mass is found to be similarly compact with few and small projecting lobes. The muscular bands around which these glands are arranged are very similar to those described in Ocnerodrilus. There are seven of these large muscular trunks on either side projecting sideways. Two of them connect with the body-wall of somite iv, two with somite v, one with somite vi and two with vii. Owing to the very lateral position of these muscular trunks they are not seen in a strictly central section, but only in extra central ones. The muscles are attached to the pharynx in the same way as in Ocnerodrilus, that is they follow the septal depressions of the pharynx, some being more lateral or central than others. The posterior and most central pair of these muscular bands does not attach to the septal glands in somite v, as they do in Ocnerodrilus, but pass independently backwards and connect with the body-wall in somite vi.

Œsophagus (figs. 1, 2, 18 and 19) commences at the posterior end of the paryngeal and buccal region, there being no gizzard. The œsophagus is greatly sacculated, much more so than in any species of Ocnerodrilus, and the expansions in the various somites are peculiarly unequal in size. This unequalness appears very constant and varies but little in the four specimens sectioned or dissected.

The anterior expansion of the œsophagus commences in the center of somite iv directly connecting with the pharynx. The part of the œsophagus which is confined to this somite is very small. In somite v the œsophagus widens, nearly always forming a very large sac which is again divided, the anterior part being the highest, projecting dorsally higher than any other part of the œsophagus.

The following part confined to somite vi is very small, both as regards width and height, being slightly lower than the posterior part of the œsophagus in somite v. In somite vii the œsophagus is greatly enlarged forming there a large inflated sac which is especially developed laterally. This part of the œsophagus is almost twice the size of any other œsophageal fold.

It is followed in somite viii by a very small and principally superiorly developed œsophageal fold which varies considerably in size, but which is always very much smaller than the œsophageal sacculation in somite vii. Seen in longitudinal section the sacculations confined respectively to somites ix, x and xi, are of almost equal size, the one in somite ix being slightly the highest. But it is much developed laterally, more so than any other part of the œsophagus

Diverticulum (figs. 1, 2, 18, 19 and 21). There is, as in Ocnerodrilus, a paired œsophageal diverticulum in somite ix, emanating in the anterior part of the somite, and not in the posterior part as in Ocnerodrilus. The junction with the œsophagus is situated in the upper part of the œsophagus and the diverticula are so bent downward that they are not seen when the œsophagus is viewed from above, being actually covered from above by the upper projecting wall of the œsophagus.

Both diverticula point directly downward and only slightly forward. They are much rounded and blunt as regards exterior form, while the inner structure resembles that of the diverticulum in Ocnerodrilus. Compared to the diverticula of *Kerria halophila*, they are much smaller than in that species. In fact the whole alimentary canal differs considerably from Beddard's form. In *Kerria halophila* there is a gizzard in somite vii, the sacculation of the œsophagus is insignificant and lastly the diverticula are very large filling the whole somite. But they connect with the œsophagus in the anterior part of the somite in the same way as in my new forms, and this appears to be a characteristic of the genus, and one to which some importance may be attached. The sacculated intestine commences in *Kerria halophila* in somite xiii, which is one somite further back than in our species. This is probably a good species characteristic, as I have found the same variation in species of Ocnerodrilus and there it appeared constant. There is only one interior cavity with large projecting ridges, one of which is much larger than the other. That these ridges in Kerria as well as in Ocnerodrilus constitute the first differentiation towards a real interior division is evident. While describing a number of species of Ocnerodrilus I failed to find a single specimen with a perfectly divided diverticulum, and I supposed that a real division did not exist. Lately, however, in examining a specimen of *Ocnerodrilus Beddardi*, I found that both of the two œsophageal diverticula were divided, one in five chambers (fig. 20) similar to those seen in cutting an orange transversely, the other in four chambers. As the worm was sectioned transversely and as I took it for granted to be an *Ocnerodrilus Beddardi*, I am not able to positively identify the species. It is, of course, not at all impossible that some other species had been collected at the same time as *Ocnerodrilus Beddardi*, the outward appearance being very slight in the various species or even genera. I am however inclined to the belief that the sections were made from an abnormally developed *Ocnerodrilus Beddardi*. Except in being perfectly divided in five distinct chambers these diverticula offered no other characteristics than those generally found in this organ in the said species of Ocnerodrilus, at least so far as could be judged from transversal sections. Probably this chambering of the diverticula is less rare than I suspect, it being only perceived in transverse and not in longitudinal sections, and it is to be presumed that in different specimens this internal subdivision has progressed unequally.

The diverticula in Kerria are less developed than in the majority of species of Ocnerodrilus. The longitudinal blood vessels which traverse it are less regular and less numerous. The collective vessel in the distal end, which is the sum of all the other vessels of this organ is also narrower than in Ocnerodrilus. The whole organ is shorter and more globular than in any species of Ocnerodrilus so far known, and it is strongly bent, the two sides touching. The exterior wall is somewhat folded. It resembles most the diverticulum of *Ocnerodrilus occidentalis*.

The diverticulum is attached to the body-wall by a very thick muscular band, much thicker than in species of Ocnerodrilus and also much shorter. The muscular band is forked after it reaches half way to the body-wall, each fork being attached to the body-wall separately.

The *tubular intestine* offers no great peculiarities. It is rather straight, much more so than any part of the œsophagus, but is still noticeably contracted at the septa, as in *Kerria holophila.* It is lined with ciliated cells as in Ocnerodrilus.

The *sacculated intestine* commences in somite xii where it is about two times as wide as the tubular intestine. It is more strongly furnished with blood sinuses and vessels than the same region in Ocnerodrilus.

Septal glands (figs. 1 and 2 *s. gl.*). There are five more or less paired septal glands surrounding œsophagus in somites v, vi, vii and viii. In appearance and arrangement they resemble the corresponding glands found in Ocnerodrilus and Gordiodrilus. The gland in somite v is the largest, the one in vi is smaller and the posterior one in viii is the smallest, being hardly perceptible. The difference in size is greater between the glands in vii and vi, than between those in vi and v. The one in vii is only about one-half the size of the one in vi. All the glands are principally developed on the upper side of the œsophagus, that part of them being much higher than the one below œsophagus. All the glands are connected by thick muscular bands with the body-wall of the somite immediately behind in the same way as in Ocnerodrilus.

Beddard does not inform us if there are septal glands in *Kerria halophila*, but we presume this to be the case. The absence of septal glands would, I think, be sufficient to separate these forms into different genera, but at present we must suppose that the septal glands in Beddard's species are present and somewhat similar to those of the other forms.

Spermathecæ (figs. 1, 13, 14, 15, 16 and 17). There are two pair of spermathecæ situated in somites viii and ix. While in Ocnerodrilus and presumably in Gordiodrilus, the spermathecæ open in front of and in line with the ventral setæ, we find them in our new species of Kerria opening in line with the lateral or outer pair of setæ. Judging from Beddard's figure of *Kerria halophila* the spermathecæ open in front of the inner couple of setæ though this is not so stated. There appears to be no diverticula in this species, but the spermathecæ are very large and appear to well fill the somites. In other respects they resemble those of our species, with the glandulous part very large and sac-like and the muscular part narrow and short.

The anterior pair of spermathecæ or those in somite viii are generally the smallest. They may be of equal size with those in somite ix but they are generally smaller, never larger. In shape the spermathecæ vary considerably, also in size. They are, however, comparatively large and very conspicuous. Each spermatheca consists of two distinct parts, one pointing towards the interior of the somites, being sac-like inflated and very much wider than the narrow tube-like and muscular part which connects the former with the body-wall and opens out in the intersegmental grove in front of the outer setæ. To these principal parts may be added a generally three-lobed diverticulum which is situated on one side of the spermatheca. This diverticulum is not always developed, and is besides variable in form and size. It is generally present on the spermatheca in somite ix, but is also often found on those in somite viii. Sometimes it is, however, of diminished size. or merely suggested by a sac-like swelling of irregular form. When fully developed the diverticulum is three-lobed, the lobes being of unequal size and irregular in form. It is affixed to the spermatheca at the junction of the muscular and sac-like parts. This sac-like part is generally ovate and regular, very much larger than the balance of the spermatheca. It exhibits the peculiarity that one side of its wall is much thicker than the other, the spermatozoa being massed against the thinner wall, leaving the space close to the thicker wall free. The muscular part of the spermatheca offers no great peculiarities. The muscles are arranged in two directions, the inner canal is ciliated. Contrary to expectation I never found any spermatozoa in the diverticula but only in the main sac-like part as has just been stated. The muscular part of the spermatheca is bent and twisted and the sac-like part is so bent toward the muscular part, that the spermatheca is almost folded on itself. The sac-like part is attached to the body-wall by a bunch of strong muscular bands two or three in number. There are no small or rudimentary diverticula at the apex of the spermatheca similar to those so often found in species of Ocnerodrilus as for instance in *Ocnerodrilus Beddardi*. The single lobed diverticulum is, in *Kerria McDonaldi*, always situated on one side of the spermatheca, and the various lobes connect before joining the main part. In one specimen the diverticulum was reduced to a simple sac-like enlargement, without secondary diverticula. The few specimens at my command did not allow of ascertaining the extent of the variations of the spermathecæ. In two of the specimens out of the four sectioned or dissected the anterior spermathecæ were much the shortest. In the third the spermathecæ were of almost equal size and in this specimen the spermathecal diverticulum was reduced to a mere sac with no side diverticula, while in two other specimens the diverticulum was three lobed as already described. The question will arise if we have not two distinct species before us, but until more material is at hand no definite answer can be given.

Sperm-sacs (figs. 1 and 27). There are generally only two sperm-sacs, which may prove to be paired. One pair in somite x and one in xi; both are very largefilling the whole available space in the somite. The body of the sperm-sac is situated principally in the upper part of the somite above the hearts and the body-wall. The sides of the sacs in somite x are thinner and project downwards, ending in a narrow tube which connects with the testes in exactly the same manner as in Ocnerodrilus. The sperm-sac in somite x is generally smaller than the one in xi. The latter is divided on each side into two large lobes, the anterior of which is the largest, both being almost globular at least when seen in a longitudinal section of the body. The under part of this sperm-sac is very much lobed and does not connect with the testes. The size of the sperm-sac is of course variable. There is no sperm-sac in somite xii, nor is there any in ix. One specimen possessed a small sac in xii.

Ovary (figs. 1 and 8). The ovary is situated as usual in somite xiii and is of the common form and size found in Ocnerodrilus. It is attached to the septum close to the body-wall in line with the inner couple of setæ. The inner matrix is palmate.

The *oviduct* is situated immediately behind the ovary and the funnel is entirely free of the septum. It is very large, deeply divided or lobed, the lobes clasping the ova almost as a pair of forceps. The ovipore is as usual situated in somite xiv, in front of the inner couple of setæ.

Two *sperm ducts* and *ciliated rosettes* (figs. 1, 23 and 27).

The one pair of ciliated rosettes are found in somites x as usual and are located exactly as in the genera Ocnerodrilus and Gordiodrilus, free and independent of the sperm-sacs. In shape the funnels are much more flattened out, being very wide and with thick margin, almost plate-like, with the posterior part narrow and somewhat twisted.

The genus Kerria must be considered to normally possess only one pair of sperm ducts and ciliated rosettes, though in one specimen I found two pair of ducts and rosettes. The spermiducal pore opens on the median papilla of the genital zone in somite xviii. The sperm duct is rather wider than in Ocnerodrilus but extremely delicate and easily ruptured and I could only ascertain its position through sections; in dissecting it always became torn. It is attached to the body-wall as usual and is very wavy, in no instance, even for a short distance, being straight, the folds doubling on themselves. The duct is cylindrical throughout without any enlargement as in some species of Ocnerodrilus and Pygmæodrilus. Beddard's observation that the rosette of *Kerria halophila* is unusually large, is also applicable to the species described here, but still the rosette does not by far stretch across the whole somite.

As already stated one specimen of *Kerria McDonaldi* possessed two pairs of sperm ducts. The ducts in each pair were entirely separated. The anterior rosette opened in x, the posterior one in xi. The anterior sperm duct opened adjoining the anterior prostate pore in xvii, while the posterior sperm duct opened in the regular typical pore in xviii. As the three other specimens contained only one pair of sperm ducts and one pair of rosettes, and as the specimen in question in all other particulars resembled the typical form we may conclude that the two ducts on either side must have been a retrograde development towards an ancestral form, and that a single sperm duct with a single rosette is the characteristic and usual feature of the genus.

Prostates (figs. 1, 23, 25 and 26). There are four prostates, two on either side, or two opening in each of the genital zones, one in the anterior angle of the crescent and one in the posterior. The prostates are short or about as long as the somite is wide, but they are much bent and generally do not extend much across the ventral ganglion, except when violently extended, when they would reach across the ventral side of the body. Their exact length, however, varies and one prostate is generally a little longer than the other. As in the allied genera we may distinguish a muscular and a glandular part of the same general nature as in Ocnerodrilus. The glandular part consists of only one layer of glandulous cells. The muscular part varies in size, and is generally of unequal length in the anterior and posterior prostate. In the two specimens which I dissected the muscular part of the anterior prostate was much longer than the muscular part of the posterior prostate, and in one specimen the muscular parts of both prostates were proportionably longer than in the other. I presume that there is considerable variation in relative size of these parts and that too much importance must not be placed on a longer or shorter prostate. Still the variation is probably within certain limits and may prove to be of value in characterizing the species as we know that in the various species of Ocnerodrilus, the relative length and width of the muscular and glandular part of the prostate is of great importance as species characters. In *Kerria McDonaldi* the glandular part of the anterior prostate was found to be about three times as long as the muscular part, while the glandular part of the posterior prostate is more than five times as long on the muscular part. The muscular part of the anterior prostate is also comparatively much narrower than the muscular part of the posterior prostate. The glandular part of the respective prostates is of much the same form. They are thickest in the vicinity of the muscular part and taper toward the inner free apex, which is narrow and pointed.

Judging from Beddard's figure of *Kerria halophila*, the prostates of those species resemble greatly those of our present form. The muscular part is longer in the anterior prostate than in the posterior one, and the glandular part of the prostate is widest close to the muscular part just as in *Kerria McDonaldi*, but they are hardly tapering as much as in that species and the inner apex is less pointed.

The prostate pores are larger than the spermiducal pores and can be seen without much difficulty, though they are by no means plainly perceptible.

Nephridia (figs. 4, 5 and 28). These organs resemble those of Ocnerodrilus and especially those of *Ocnerodrilus Beddardi*. The anterior nephridia are devoid of large peritoneal cells, while in those posterior of the clitellum the upper part of the tubes are entirely hidden by these cells.

The five nephridia anterior to somite ix are small, always devoid of peritoneal cells. The nephridia in ix are much larger, furnished with some peritoneal cells, those in x and xi are smaller. After these the nephridia gradually increase in size, those in the extreme posterior part of the body being always the largest and of equal size. The peritoneal cells gradually increase in number toward the last quarter of the body, but this increase is quite irregular. In some specimens these cells are many, almost filling the whole somite, in others they are few, in some specimens the cells commence much more anteriorly than in others, but the nephridia in the posterior part—the fourth quarter—of the body are always covered with the same quantity of cells and are of the same large size. This is precisely the case in Ocnerodrilus, in the various species of which the nephridia are fairly constant in size and form and characteristic of the species.

Setæ (figs. 9 and 10). The setæ are all sigmoid and of the regular lumbricid pattern and in couples of two, or 8 in each somite. The setæ in the three somites of the genital zone are about ⅓ smaller than those outside of the zone. The free end of the seta is generally sculptured with small pointed cavities, but I also found some setæ in which those cavities could not be defined. In this species all the setæ in the genital zone were present and I think that this will prove a constant characteristic by which this and the following species may be distinguished. The common setæ in this species are a trifle wider, but not quite as long as in the following species.

The *cephalic ganglion* (fig. 22), is narrower than in Ocnerodrilus and the lobes less prominent. The ventral ganglion is much nipped by the septa and is raised up above the intersegmental furrow in a way which I have not observed in Ocnerodrilus. The ventral ganglion sends out two pair of large nerve ganglia toward either side. The anterior one of these is situated in the anterior quarter of the ganglion and is by far the smallest, only half as wide as the posterior ganglionic branch, which is broad, paired and situated quite close to the posterior septum, about midway between it and the setæ.

The *vascular system* (fig. 1) is closely allied to that of Ocnerodrilus. The ventral vessel is connected with the dorsal vessel by two pair of large hearts in x and xi. The blood is dark red. The vessels in the œsophageal diverticulum are less regular and parallel than in Ocnerodrilus, and some of them even branch and give off small secondary projections. They are fewer than in *Ocnerodrilus Beddardi*, more resembling those of *Ocnerodrilus occidentalis*. They do not anastomose. They collect in the distal end to a vascular trunk which runs forward as in Ocnerodrilus, but is much smaller and less developed. The lateral longitudinal trunk gives off branches to the septal glands in the usual way. The dorsal and ventral vessels send off secondary vessels to the dermal system, in almost precisely the same manner as in Ocnerodrilus and these vessels do not connect with each other, but branch on the body-wall respectively on the upper and lower sides of the body. The elaborate capillary system, which in Ocnerodrilus occupies the anterior two somites, is in Kerria somewhat less developed. But the intestinal vascular system in somites ix to xx is much stronger than in Ocnerodrilus, the blood sinuses and vessels sometimes approaching the hearts and dorsal vessels in size and quantity of blood.

Kerria zonalis *n. sp.*

Figs. 12, 13, 29 and 30.

One pair of spermathecæ in somite ix. Eight prostates, two and two opening close together in each end of the genital zone. The outer setæ in the inner couples in somites xvii and xix are missing.

Habitat. In the same locality as the preceding species. Only one specimen found.

Of this interesting form I can unfortunately not give a complete diagnosis as part of the single specimen was destroyed before I recognized it a separate species. Evidently it much resembles the preceding species. The absence of spermathecæ in somite viii is of less importance and may not prove constant. The spermathecæ in somite ix were of similar size and construction as those in the preceding species, though of somewhat different form.

The most important characteristics of this species are found in the genital zone and prostates. As has already been stated the outer seta in the inner couple both in somites xvii and xix are missing. The central papilla in the genital zone is smaller than in the preceding species, but otherwise the zones in the two species resemble each other. The sperm ducts are smaller than in the preceding species. The prostates are eight in number, longer and more slender than in *Kerria McDonaldi*. The muscular parts of the prostates are not as narrow as in the preceding form and they are less regular and much shorter. There is no difference between the anterior and the posterior prostates, except that one prostate in each couple is slightly larger than the other, but I doubt if this is a constant character.

All the prostates resemble in a general way the posterior prostate in the preceding species, the muscular tube in each being comparatively short, gradually increasing in size towards the glandular part. The prostates are also less pointed. They are contracted several times and rather wavy and irregular in outline with two distinct swellings. All the papillæ in the genital zone are less prominent than in *Kerria McDonaldi*.

As I found only one specimen and that one being partly damaged, I can give no account of the septal glands, etc. We must look to a larger supply of specimens before an extensive description can be made, but I think enough is known to warrant us to arrange this worm as a separate species.

According to Beddard the genital setæ in *Kerria halophila* are similar to and thus not smaller than the other setæ. The difference in size of the setæ is therefor only a species characteristic, but one of considerable importance as it is an exterior character which does not require dissection to be descernible.

Systematic position. Beddard has already commented upon the relationship of Kerria with other genera, and he inclines strongly to place it near Acanthodrilus, as well as Ocnerodrilus and Gordiodrilus. I believe, however, that the relationship with Ocnerodrilus, Gordiodrilus and Pygmæodrilus is greater and that those three genera with Kerria may be arranged in one large group, though not in the same family. The presence of blood vessels on the nephridia appears in my opinion to further separate Acanthodrilus from the other genera in question, and so does undoubtedly the double row of cells of the prostates. The size, shape and diverticula of the spermathecæ of Kerria resemble more closely those of Acanthodrilus than Ocnerodrilus, etc. But of all the genital organs the spermathecæ are those which vary the most, even within the limits of one species.

SPECIES OF KERRIA.

Kerria:	*McDonaldi.*	*zonalis.*	*halophila.*
Genital setæ	Smaller.	Smaller.	Not smaller. ?
Outer genital setæ in xvii and xix	Present.	Wanting.	Present.
Spermathecæ	With diverticula.	With diverticula.	No diverticula.
Muscular part of anterior prostate	Longer.	Not longer.	Longer.
Prostates on each genital zone	Two.	Four.	Two.
Gizzard	None.	None.	One in vii.
Œsophagus	Sacculated.	Sacculated.	Not Sacculated.
Sacculated intestine commences in	xii.	xii.	xiii.
Spermathecæ open in line	With outside setæ.	With outside setæ.	With inner setæ.

PAPERS REFERRED TO.

FRANK E. BEDDARD. On the Anatomy of Ocnerodrilus. Proceedings Royal Society of Edinburgh. Vol. 36, pages 563 to 583.

FRANK E. BEDDARD. On a New Genus of Oligochætæ, Comprising Five New Species Belonging to the Family Ocnerodrilidæ. Annals and Magazine of Natural History, No. 55, July, 1892, page 74, plates vi and vii.

FRANK E. BEDDARD. Abstract of some Investigations into the Structure of the Oligochæta. Annals and Magazine of Natural History, Jan., 1891, p. 88.

FRANK E. BEDDARD. On some Aquatic Oligochætous Worms. Proc. Zool. Soc. 1892, No. xxv.

DANIELE ROSA. Sui genere Pontodrilus, Microscolex and Photodrilus. Bollettino dei Musei di Zoologia, Universita di Torino, vol. iii, No. 39, Marzo, 1888.

W. B. BENHAM. An attempt to Classify Earth-worms. Quatr. Journal of Microscopical Science, vol. xxxi, part ii, p. 201.

GUSTAV EISEN. Anatomical Studies on New Species of Ocnerodrilus. Proc. Cal. Acad. Sci., 2d seres, vol. iii, Jan. 19, 1893.

EXPLANATION OF THE FIGURES.

Plate XI.

Kerria McDonaldi, fig. 1 to 12.

Fig. 1. Semi-schematic view of the organs of the anterior somites as seen from above.

bc. buccal cavity.
br. brain.
phx. pharynx.
sl. gl. salivary glands of the pharynx.
s. gl. septal glands of the œsophagus.
nph. nephridia.
spth. spermatheca.
dvt. diverticula of the œsophagus seen from above; partly hidden by the œsophagus.
h. heart.
ss. sperm-sacs.
o. ovary.
od. oviduct.
s. septa.
cl. clitellum.
pr. prostates.
v. gl. ventral ganglion.
s. i. sacculated intestine.
sp. d. sperm ducts.

Fig. 2. Some of the organs of the anterior somites seen from the side in a longitudinal section. The nephridia are not delineated and only a part of the vascular system is shown.

prst. prostomium.
per. peristomium.
phx. pharynx.
sl. gl. salivary glands.
br. brain.
œs. œsophagus.
s. gl. septal glands.
dvt. diverticulum of the œsophagus.
h. hearts.
d. v. dorsal vessel.
v. v. ventral vessel.
s. i. sacculated intestine.
t. i. tubular intestine.

Fig. 3. The genital zones seen from below and from the outside of the body.

pr. prostate pore.

♂. male pore.

v. gr. ventral groove between the two zones; the points of the setæ are seen protruding.

Fig. 4. A nephridium from somite xiii.

Fig. 5. The inner funnel of a nephridium.

s. septum.

Fig. 6. Longitudinal section of the genital zone compiled from two celloidin sections.

g. z. genital zone.

pr. prostates.

sp. d. sperm ducts.

p. s. genital or copulatory setæ.

Fig. 7. One of the epidermal appendages of the genital zone.

Fig. 8. Ovary and oviduct.

o. ovary.

od. oviduct.

Fig. 9. One of the genital setæ of the inner couples in somites xvii, xviii and xix.

Fig. 10. One of the common setæ.

Fig. 11. Natural size.

Kerria zonalis, figs. 12, 13.

Fig. 12. Common setæ. The genital setæ are similar to fig. 9.

Fig. 13. Testis and sperm-sac showing their connection.

t. testes.

ss. sperm-sac.

PLATE XII.

Kerria McDonaldi, figs. 14, 18, 21 to 27.

Fig. 14. Schematic view of the spermathecæ and their position in front of the outer setæ in somites ix and viii.

Fig. 15. One of the anterior spermathecæ, sectional view.

m. s. muscular part.

sc. spermathecal sac.

spz. spermatozoa.

Fig. 16. Another of the anterior spermathecæ, outside view.

Fig. 17 and 18. Two of the posterior spermathecæ, outside view, showing the diverticula *dvt.*

Fig. 19. Part of the œsophagus, with diverticula, tubular intestine and sacculated intestine, seen from above. Only the beginning of the diverticula is visible.

Fig. 20. The same seen from the under side with the diverticula spread out.

dvt. diverticula.

cl. collecting vessel.

Fig. 21. Diverticulum of the œsophagus, seen in cross-sections.

v. blood vessels.

ep. epithelial lining.

Fig. 22. Brain and ventral ganglion spread out.

Fig. 23. The genital zone more highly magnified than in fig. 3.

♂. male pores.

pr. prostate pores.

c. s. common setæ, large size.

p. s. penial setæ of smaller size.

Fig. 24. The anterior part of the body seen from the side.

Fig. 25a. One of the anterior prostates.

Fig. 25b. Anterior prostate of another specimen.

Fig. 26a. One of the posterior prostates.

m. s. muscular part.

gl. glandular part.

Fig. 26b. Posterior prostate from another specimen.

Fig. 27. Ciliated rosette and sperm duct and sperm-sacs in x and xi.

Fig. 28. One of the posterior nephridia with peritoneal cells.

Kerria zonalis, figs. 29, 30.

Fig. 29. The genital zone and surrounding somites withthe prostates and sperm ducts seen from the inner side of the body.

pr. a. anterior prostates.

pr. p. posterior prostates.

sp. d. sperm ducts.

c. s. common setæ.

p. s. penial setæ of smaller size than the common setæ.

m. s. muscular part of the prostate.

gl. glandular part of the prostate.

Fig. 30. The inner pore of the posterior prostates.

m. s. muscles keeping the prostates in position.

pr. prostates.

pa. papilla.

intp. interpapillary groove.

Ocnerodrilus Beddardi, fig. 31.

Fig. 31. Abnormal five chambered diverticulum, seen in cross-section.

v. blood vessels.

ep. epithelial lining.

AN ILLUSTRATION OF THE FLEXURE OF ROCK.

BY GEORGE H. ASHLEY.

Exposures of the axes of anticlines or synclines often show the beds of rock bent into an arc of very short radius, yet without perceptible fracturing.[1] As rocks are generally considered inflexible, except when softened by heat, a question naturally arises concerning the conditions under which these rocks have yielded and formed such close flexures without breaking.

The old theory is that it is due, first, to the great vertical pressure of the superincumbent beds of rock as a passive factor,[2] and second, a greater horizontal pressure as the active factor.[3] Thus, it is conceived that the horizontal pressure, from whatever source, gradually accumulates until it is able not only to overcome the resistance to bending of the layers, hundreds or thousands of feet thick, but also to lift the weight of all the overlying beds. Then bending will ensue. But it is assumed that though the layers may be under a shearing stress far beyond their strength of resistance the great vertical pressure will prevent rupture by immediately forcing together every incipient fracture.[4] These incipient fractures, however, relieve the horizontal pressure which is converted into heat[5] and this heat in turn assists the vertical pressure in the mending process. Thus giving way in

[1] See for example, Reade's Origin of Mountain Ranges, pp. 177, 186, 189, plate 24, etc.; Geol. Surv. of Ark., Vol. III, 1890, pl. VIII; other reports on regions of much folding.

[2] K. Clark's Tables for Engineers, 1st ed., pp. 631 and 204.

[3] Nature, XIX, (1878), p. 103; Daubrée, Géol. Expérim., pp. 290 *et seq.*

[4] Spring in Bull. Acad. Roy. Belg., 1880, pp. 171 and 325; Spring in The Engineer, Apr. 9, 1886, p. 278.

[5] Prestwick's Geology, Vol. I, p. 410; Daubrée's Géol. Expérim., pp. 448 *et seq.*; Mallet in Phil. Trans., 1873, p. 187.

minute slippings, the layers in time become folded, and when the movement has ceased and erosion exposed them, they appear intact.

In many cases, as shown by microscopic examination of the rocks, this may be the true explanation,[6] but of late the belief has been gaining ground that by introducing the factor of viscosity of solids under stress the same results may be obtained without resorting to fracturing at all.[7]

It has long been known that in igneous and metamorphic rocks when heated, the particles have a certain freedom of motion among themselves called flow, similar to the flow of any plastic substance like putty under the slight pressure of the hand.[8]

M. Tresca and others have shown that similar flow occurs in cold solid bodies when subjected to a pressure above the elastic limit and below the ultimate strength.[9]

In application of this principle, if we suppose a horizontal pressure acting upon a layer of rock which at some point is not quite horizontal, the initial pressure will at that point be resolved into two components, one

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[6] Geikie's Textbook of Geol., pp. 292–3, 506, 575 and 578.

[7] Reade's Origin of Mountain Ranges, pp. 91 and 92; Becker in Bull. Geol. Soc. Am., Vol. 4, 1893, pp. 13–90.

[8] King, U. S. Geol. Exp. 40th Par., Vol. 1, p. 752; Callaway in Quat. Jour. Geol. Soc., 1883, p. 383; Barus in Am. Jour. Sci., III, Vol. 36, p. 178; III Vol. 39, p. 234; Prestwick's Geology, Vol. I, p. 304; Heim's Mechanics mus der Gebirgsbildung, 1878.

[9] Tresca in Comtes Rendus, Vol. 59, 1864, p. 754; Vol. 64, 1867, p. 809; Tresca in Mém. Sav. Étrangers XVIII, p. 733; XX, p. 75; Tresca in Inst. Mech. Eng., June, 1867; June 1878; Tresca in The Engineer, June 28, 1878, p. 463; June 14, 1878, p. 428; Townsend in Jour. Franklin Inst., March, 1878; Williams in Gentleman's Mag., Feb., 1883, pp. 231–2; Spring in The Engineer, Apr. 9, 1886, p. 278; Barus, Bull. U. S. Geol. Surv., No. 73; Becker in Bull. Geol. Soc. Am., Vol. 4, 1893, p. 51, also p. 13 *et seq;* Barus in Am. Jour. Sci., III, Vol. 45, Feb., 1893, p. 87.

tending to compress and the other to bend the layer. If this bending component be great enough, the result will be the same as when the ultimate strength of any rigid substance is overcome, viz., deformation with rupturing; if it be below the ultimate strength but above the elastic limit and be applied gradually, flow, or in other words deformation without rupturing, will take place.

But what is the elastic limit? Experiments, as well as common observation, show that the limit of elasticity depends upon the time. Thus, if a rod or bar of glass, ice or stone, supported at its ends be struck in the middle, it will either break or regain, approximately, its original position, showing that the limit of elasticity is practically as high as the ultimate strength. On the other hand, if, by means of small weights, pressure be applied gradually and slowly, the same rod may be bent, and in time will exhibit a permanent deformation or set.[10] This shows that even the time of a laboratory experiment, necessarily limited, is sufficient to make the elastic limit, and correspondingly the force necessary to produce flow, much lower than in the case first supposed.

All this suggests the following conclusion: Assuming that the resultant of all the forces acting upon the particles at any point in a layer of rock, if below the ultimate strength and above the elastic limit of the layer, will produce flow in its own direction, we can say, that if the proper ratio between this resultant and the time through which it acts be maintained, flow will ensue, even though the resultant be indefinitely diminished. There seems to apply here the mathematical law that a side which has any per cent. in its favor, no matter how small, will, if given time enough, ultimately win.

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[10] Miall in Pop. Sci. Review, Jan., 1872.

In other words, vertical pressure is not necessary to prevent the breaking of folding beds of rock when time enough is given for a small horizontal force to act. It does not concern us now whether this be true if carried to its smallest limit.

No experiments on rocks covering any extended period of time seem to have been carried on,[11] but a few cases have been observed in which most of the conditions of such an experiment have been fulfilled and sufficient time has elapsed to make the results pronounced.[12] In but one of these have measurements been made and published.[13]

The following notes on a slab of marble bending under its own weight are offered as a contribution to observations upon this subject. The slab in question covers a grave in the Laurel Hill Cemetery, San Francisco, not far from the corner of California Street and Central Avenue. It is three-fourths of an inch thick, six feet four inches long, two feet six inches wide and lies in a horizontal position. As far as could be determined, the slab was laid upon the prepared earth, which at this point is clay, without support of brick, cement or other material.

It could not be learned just when the slab was put in place, but it was not earlier than 1882, nor later than 1884. Subsequently the ground settled, and the slab being then supported only near the ends, bent as shown in the illustrations.

The position of the supporting earth could not be determined, but it probably occupies an irregular area near

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[11] Miall in Pop. Sci. Review, Jan. 1872.

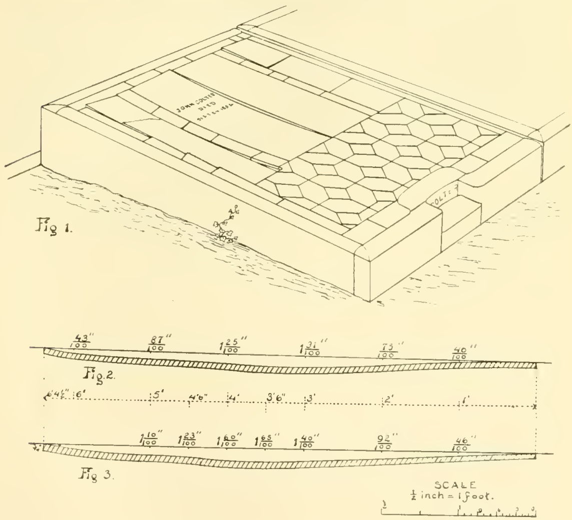
[12] Becker in Bull. Geol. Soc. Am., Vol. 4, 1893, p. 51; King, U. S. Geol. Exp. 40th Par., Vol. 1, p. 752.

[13] Winslow, Am. Jour. Sci. III, Vol. 43, 1892, p. 133.

the head and foot of the slab, that near the head being a little distance from the end, for that end is raised slightly above the general level.*

Fig. 2 shows the deflection from a straight line drawn over the terminal edges of the further side of the slab bearing the name. Fig. 3 shows the same for the nearer side. The maximum deflection is 1.65 inches. The measurements were taken with a finely divided steel rule and tape.

Minor flexures occur at several places showing an extreme sensitiveness of the slab to stress. In this case,



* Sketch of grave in Laurel Hill Cemetery, San Francisco, California, showing deflection of a slab of marble due to its own weight. Dimensions of slab 6 ft. 4 in. by 2 ft. 6 in. by ¾ in. Put in place in 1882.(?) Measurements taken December, 1892.

however, bending seems to have about reached its limit, as a thread-like crack about two inches long and 24½ inches from the head of the slab can be detected on the side toward the observer.

As shown, other slabs cover other parts of the group of graves and of these, two are bent more or less but not as much as the one described.

If 160 pounds be taken as the weight of a cubic foot of marble (a fair average), the weight of a prism an inch square and the thickness of the slab will be almost .07 of a pound. We may therefore consider .07 of a pound to the square inch as the bending pressure.

Considering the curve of the slab an arc of a circle, a continuous piece of limestone having the same curve would form a closed circle with a radius of 37 feet.

In summary, a slab of marble ¾ of an inch thick under a stress of .07 of a pound per square inch has in 10 years become flexed one forty-sixth of its length.

GEOLOGICAL SURVEYS IN THE STATE OF CALIFORNIA.

BY ANTHONY W. VOGDES.

The want of a compilation of the works on the geology of California has long been felt by the workers in this department of natural science; the author has, therefore, collected with considerable care all of the most important official publications on the subject, and he hopes that it will be found in some degree useful to the geologists of the Pacific Slope.

I. United States Government Reports.

Report of the Exploring Expedition to the Rocky Mountains in 1842 and in Oregon and North California in the years 1843–44, by Capt. J. C. Fremont, U. S. Army. Washington, 1845, 693 pp., 24 plates and 3 maps. 28 Cong., 2d Session, Senate Doc. 174.

Geographical Memoirs upon Upper California in Illustration of his Map of Oregon and California, Capt. John C. Fremont, Washington, 1848, 67 pp. Map of same. 30 Cong., 1 Session, Sen. Misc. Doc., 148.

Notes of a Military Reconnoissance from Fort Leavenworth in Missouri to San Diego in California; including parts of the Arkansas, Del Norte and Gila Rivers, by Maj. W. H. Emory, U. S. Army. Washington, 1848, 416 pp., 41 plates and map. 30 Cong., 1st Session, Ex. Doc. 41.

Report of Lieut. Col. P. St. George Cooke of his march from Santa Fé, New Mexico, to San Diego, Upper California. Washington, 1848, 13 pp. and map. 30 Cong., 1st Session, Ex. Doc. 41, pp. 551–563.

Journal of Capt. A. R. Johnson, U. S. Army. (Expedition from Santa Fé to San Diego.) Washington.

1848, 48 pp. 30 Cong., 1st Session, Ex. Doc. 41, pp. 567–614.

Journal of the march of the Mormon battalion of Infantry Volunteers, under the command of Lieut. Col. P. St. George Cooke, from Santa Fé, New Mexico, to San Diego, California, etc. Washington, 1849, 85 pp. Special Session, Senate Doc. 2.

U. S. Exploring Expedition under the command of Charles Wilkes, U. S. Navy, Vol. X, Geology by James D. Dana. Philadelphia, 1849, pp. xii, 9. 756, 5 maps. Folio atlas of 21 plates.

Report of Hon. T. Butler King on California. Washington, 1851, 72 pp. This report was printed by order of the House of Representatives.

PACIFIC RAILROAD REPORTS.

Vol. iii. Résumé of a Geological Reconnaissance, extending from Napoleon, at the junction of the Arkansas with the Mississippi, to the Pueblo de Los Angeles in California, by Jules Marcou. This résumé was reprinted from the preliminary report of Lieut. Whipple. House Doc., 129, Washington, 1855.

Vol. v, 1857. Routes in California to Connect with the Routes near the 35th Parallel and 32d Parallel, explored by Lt. R. S. Williamson in 1853, Geological Report by William S. Blake.

Vol. vi, 1856. Geological Reports of Routes in California and Oregon, explored by Lts. R. S. Williamson and H. L. Abbott, by John S. Newberry.

1. Geology of the Vicinity of San Francisco.
2. Geology of the Sacramento Valley, etc., etc.

Vol. vii, 1856. Routes in California to Connect with the Routes near the 35th and 32d Parallel and Routes near the 32d Parallel between the Rio Grande and Pimas Villages, explored by John G. Parke in 1854–55. Geological Report by Thomas Antisell.

Description of the Fossils and Shells Collected in California, by William P. Blake, Washington, 1855. H. Doc., 129, 34 pp.

Report of the Secretary of War.

Report of P. T. Tyson upon the Geology of California. Washington, 1850, 74 pp., 9 sections and one map.

Part 2. Report of the Secretary of War in further compliance with the resolution of the Senate calling for copies of Reports on the Geology and Topography of California. Washington, 1850. 37 pp. and 3 maps. 31st Cong., 1st Session, Senate, Ex. Doc., 47.

Geology and Industrial Resources of California, by Philip T. Tyson, Baltimore, 1851. xxxiv, 127 and 37 pp., 9 sections and 3 maps.

United States and Mexican Boundary Survey.

Palæontology and Geology of the Boundary, by James Hall. Description of Cretaceous and Tertiary Fossils, by T. A. Conrad. Washington, 1857. 34th Cong., 1 Session, Senate Ex. Doc., No. 108.

Report Mineral Resources United States.

Report of 1867. Historical Sketch of Gold and Silver Mining on the Pacific Slope, by J. Ross Browne and James W. Taylor. pp. 13–36.

——— Geological Formation, etc., of the Pacific Slope, by William Ashburner. pp. 37–49.

——— Condition of Gold and Silver Mining on the Pacific Coast, by J. Ross Browne and James W. Taylor. pp. 49–85.

Report of 1867. The Copper Resources of the Pacific Slope. Geological Formation in which Copper is found, by J. Ross Browne and James W. Taylor. Section v, pp. 138–169.

——— Quicksilver mines of California (for Borax, Sulphur, Tin and Coal, see Sec. vii), by J. Ross Browne and James W. Taylor. Sec. vi, pp. 170–178.

——— Report on the Coal Deposits of the Pacific Slope, by W. M. Gabb. pp. 188–193.

——— Annotated Catalogue of the Principal Mineral Species hitherto Recognized in California and the adjoining States and Territories, by William P. Blake. Section ix, pp. 200–212.

——— Notes on the Geographical Distribution and Geology of the Precious Metals and Valuable Minerals on the Pacific Slope of the United States, by J. Ross Browne and James W. Taylor. pp. 212–215.

Report of 1868. General Condition of the Mining Interest, by J. Ross Browne. pp. 12–298.

Report of 1869. Notes on California, by R. W. Raymond. pp. 9–33.

Report of 1870. Condition of Mining Industry. pp. 13–87.

Report of 1872. Condition of Mining Industry in California. pp. 13–140. (The Formation of Gravel Deposits, p. 55.) (Section of Table Mountain, p. 62.)

Report of 1873. Condition of Mining Industry in California. pp. 7–107.

Report of 1873. The Pliocene Rivers of California, by Amos Bowman. pp. 377–389.

Report of 1874. Condition of Mining Industry in California. pp. 11–156. Klamath County. Geological

Sections, p. 145, by A.W. Chase. Nevada County. Map of Gravel Deposits, p. 108.

Report of 1875. Condition of Mining Industry of California, pp. 11–194. (Lignites, p. 75.)

Report of 1876. Condition of the Mining Industry in California. pp. 3–132. Geology of Plumas County, by J. A. Edman. p. 109. One map.

——— Geology of the Sierra Nevada in its Relation to Vein Mining, by Amos Bowman. pp. 441–470.

U. S. Coast Survey.

Report of 1855. Observations on the Physical Geography and Geology of the Coast of California from Bodega Bay to San Diego, by W. P. Blake. pp. 376 to 398. Four plates.

Colorado Exploring Expedition.

Geology of the Coast of Southern California, by John S. Newberry, Washington, 1861.

U. S. Geographical and Geological Survey West of the 100th Meridian.

Vol. iii, Part 1. Report on the Geology of portions of Nevada, Utah, California and Arizona examined in the years 1871–2, by G. K. Gilbert.

Report of 1876. Report on the Geology of a portion of Southern California, by Jules Marcou. pp. 378–419.

——— Report on the Geology of the Mountain Ranges from La Veta Pass to Head of the Pecos, by A. R. Conkling. pp. 419–22.

Report of 1877. Geological Report on the portions of Western Nevada and Eastern California between the parallels 30° 30′ and 38° 30′, by A. R. Conkling. Appendix H., pp. 1285–1295.

United States Geological Survey.

J. W. Powell, Director.

On the Mesozoic and Cenozoic Palæontology of California, by C. A. White. Bull. No. 15, Vol. 3, 1885. 33 pp.

Notes on the Stratigraphy of California, by Geo. F. Becker. Bull. No. 19, Vol. 3, 1885. 28 pp.

On New Cretaceous Fossils from California, by C. A. White. Bull. No. 22, Vol. 3, 1885. 25 pp. 5 Plates.

Notes on the Geology of California, by J. S. Diller. Bull. No. 33, Vol. 5, 1886. 23 pp.

Monographs, Vol. xiii. Geology of the Quicksilver Deposits of the Pacific Slope, with atlas, by George F. Becker. Washington, 1888. xix, 486 pp. 7 pls. and atlas of 14 sheets folio.

8th Annual Report, 1889. Quaternary History of Mono Valley, California, by Israel C. Russell. pp. 261–394. 24 plates and 5 maps.

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Summary of the Geology of the Quicksilver Deposits of the Pacific Slope, by Geo. F. Becker. pp. 961–985. 3 plates.

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J. D. WHITNEY, DIRECTOR.

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Map of Region Adjacent to the Bay of San Francisco. 2 miles = 1 inch. New York, 1873. In portfolio. 2 sheets. Map of Central California, n. p; n. d.

Map of California and Nevada, by F. v. Leicht and A. Craven. 18 miles = 1 inch. New York, 1873. Colored. Revised by Hoffman and Craven. New York, 1874.

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California State Mining Bureau.
Henry G. Hanks, State Mineralogist.

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Fifth Annual Report of the State Mineralogist for the year ending May 15, 1885. Sacramento, 1885. 235 pp., 1 plate and 4 sections.

Sixth Annual Report of the State Mineralogist, Part 1, for the year ending June 1, 1886. Sacramento, 1886. 145 pp. and 1 map.

First Annual Catalogue of the State Museum of California being the collection made by the State Mining Bureau during the year ending April 16, 1881. Sacramento, 1882. p. 350.

Catalogue of Books, Maps, Lithographs, Photographs, etc. in the Library of the State Mining Bureau at San Francisco, May 15, 1884. Sacramento, 1884. 19 pp.

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California State Mining Bureau.

William Irelan, Jr., State Mineralogist.

Sixth Annual Report of the State Mineralogist, Part 2, for the year ending June 1, 1886. Sacramento, 1887. 222 pp., illustrated.

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Eighth Annual Report of the State Mineralogist for the year ending October 1, 1888. Sacramento, 1888. 948 pp., illustrated.

Ninth Annual Report of the State Mineralogist for the year ending December 1, 1889. Sacramento, 1890. 352 pp. and 34 plates.

Tenth Annual Report of the State Mineralogist for the year ending December 1, 1890. Contains Geological Map of California. Sacramento, 1890. 981 pp., maps and plates.

Bulletin No. 1. A description of the desiccated human remains in the California State Mining Bureau, by Winslow Anderson, M. D. Sacramento, 1888. 41 pp. and 6 plates.

Catalogue of the Library of the California State Mining Bureau, San Francisco, California. September 1, 1892. Sacramento, 1892. 149 pp.

ON LAND AND FRESH WATER MOLLUSCA OF LOWER CALIFORNIA. No. 3.

BY J. G. COOPER.

This paper is a continuation of the article on p. 207, where a part of the Lower California land and fresh-water shells are described or mentioned.

COLUMNA RAMENTOSA J. G. C. 1891. Plate xiii, fig. 1.

Rhodea californica var. *ramentosa*, l. c., p. 215, etc.

Nuclear whorls 2, turbinate, abruptly truncate, with numerous fine vertical ribs, on third becoming oblique and parallel to lines of growth, on all the others crossed by 10 to 15 transverse striæ parallel to sutures, producing a file-like sculpture. Whorls 13 to 16 slightly convex, cylindrical and nearly equal, the 7th to 11th usually largest, then diminishing and penultimate whorl also narrowed vertically to size of 8th. Body whorl swollen on left side, and with 2 deep constrictions about equidistant between base and suture, extending from outer side of lip to middle of dorsal surface, not visible inside of mouth. Peristome slightly expanded and thickened, suboval, pointed above, inner lip continuous across columella, leaving an umbilical sinus, which continues as a perforation throughout axis of shell, mouth of shell large, expanded, base rounded. Immature shell with the base angular, forming a rhomboid mouth.

Length 0.95 to 1 inch, breadth 0.18; mouth 0.19 long, 0.17 wide; color white, translucent.

Habitat.—Foothills near San José del Cabo, Lower California, 15 specimens near edge of lagoons, one in a cave. *W. E. Bryant* and *G. Eisen*.

COLUMNA (var.?) ABBREVIATA J. G. C. 1892. Plate xiii, fig. 2. See *ante*, p. 215.

Nuclear whorls, 1½, vertically flattened, the others reduced to 8 or 9, the 7th largest, 6th and 8th about equal and much smaller, penultimate not narrowed and larger than fourth. Outline swollen at middle, contracted at suture of body-whorl, which is shorter vertically than in *C. ramentosa*. Mouth subcircular, subacutely pointed at its apex, near suture, the constrictions on body-whorl deep, partly visible inside, otherwise as in *ramentosa*. A very thin brownish epidermis covered the living shell.

Length 0.85, breadth 0.19 inch; mouth 0.22 long, 0.18 wide.

Five found on higher part of the range of *C. ramentosa* by Dr. Eisen.

This might well be considered a distinct species if there were not some indications of intermediate characters, and until more are known we may attribute the variations to environment, local influences producing a stunted race.

MELANIELLA? EISENIANA n. sp. Plate xiii, fig. 3.

Shell sinistral, with a thin brownish epidermis, first two nuclear whorls white, smooth, turbinate, third narrower, and with the rest covered with numerous vertical riblets, increasing to about 50 on body-whorl, where they curve round the base and end at the edge of lip. Whorls 17 to 19 regularly and slowly enlarging from the 3d to the body-whorl, which is contracted about one-third, flattened, sutures moderately impressed, truncating the riblets. Penultimate whorl swollen, largest, narrowing toward mouth, which is ovate, acute at junction of lips, of which the outer crosses the inner, ending at the sutuse.

Length about 0.55 inch, breadth 0.14; mouth 0.08 long, 0.09 wide. Shell transparent.

Fourteen found by Dr. Eisen under stones living, but the epidermis being destroyed by alcohol they do not have exactly the color of fresh ones.

Considerable difference is shown in the shell from the species figured by W. G. Binney as of this "subgenus of Stenogyra," and it is very doubtful if it is related to it, or to the family Stenogyridæ, which has a jaw of one piece, which this certainly has not. Its dissection has not, however, been completed, and it seems externally to have more relations with Cylindrella.

BULIMULUS INSCENDENS BRYANTI J. G. Cooper. Plate xiii, fig. 4.

For description of this subspecies see *ante*, p. 101.

BULIMULUS INSCENDENS BELDINGI J. G. C. Plate xiii, fig. 5.

Described in these Proceedings, vol. iii, p. 209, 1892. (The latitude of Punta Arena there given as 25° 30′ should be 23° 30′.)

This subspecies being most common at a high elevation, its differences from the lowland type may be due to the same environing influences that have produced the stunted form of *Columna*. The occurrence of a few specimens near sea-level may be caused by mountain torrents having washed down a few, which have, perhaps, established a temporary colony there.

BULIMULUS SUFFLATUS INSULARIS J. G. C. Plate xiv, fig. 6.

Same reference, p. 212.

BULIMULUS GABBI Crosse & Fischer.

Since the article above referred to was published, in which I showed the close resemblance of this to *B. Xantusi* W. G. B., I have seen the plate and description by C. & F. in the Mollusques du Mexique, and there is certainly much reason to consider their *B. gabbi* as not more than a subspecies at most of *B. Xantusi*, of which they merely copy Binney's figure and description. While some differences exist, they are not so great as those seen in the subspecies of *B. inscendens* here given.

HELIX AREOLATA EXANIMATA J. G. C. Plate xiv, fig. 7. Same reference, p. 216.

PLANORBIS (ANISUS) ANITENSIS n. sp. Plate xiv, fig. 8. Shell (when held mouth downward) with the right side concavo-convex, the left flat (or slightly concave), the left margin forming a sharp carina expanded beyond the solid edge of shell, which is marked by a compressed line. Whorls 5, visible on both sides, uniformly flat on the left side, forming a concave umbilicus on the right, where their surface is rounded. Mouth triangular, the right lip arched, the left nearly flat, the extremities joined to outer angle and to obtuse margin of umbilical cavity. Umbilicus half as wide as the shell; flat side of mouth one-fourth of diameter; greatest breadth (at mouth) over one-fifth of same; greater diameter 0.26, least 0.03 inch.

Habitat.—Four specimens found in a laguna at Santa Anita, Lower California, at an elevation of 100 feet, and 10 miles from San José del Cabo, Lower California.

This species seems to come nearest to some of those of tropical America, as *P. kermatodes* Orbigny, which differs in larger size, etc. It approaches also to *P. planorbis* Linné (*marginatus* Drap.) and *P. nitidus* Muller of Europe, but none seem to be so much flattened or doubly concave. The only similar North American species is *P. exacutus* Say, which also differs in being lenticular in form (or doubly convex in outline). That species is also unknown nearer than Vancouver Island and Kansas, 2,000 and 1,000 miles distant. A comparison of this shell with *P. (Menetus) opercularis* Gould, shows that it is reversed, the flattened side bein[g] the *right* in that shell, which Dr. Gould describes a[s] [...]al.

It may be noted here that Mr. Binney, in Land and Freshwater Shells, part 2, p. 127, figures as a variety of *P. exacutus* the shell called "*Paludina hyalina* Lea," in which the spire is raised in a conical form, tending to prove that the species is really dextral. On this account I have described these shells as if in the vertical position in which they are carried by the animal.

PLANORBIS (ANISUS?) PENINSULARIS n. sp. Plate xiv, fig. 9.

Shell with both sides concave, the right with whorls rounded, their edge forming an obtuse margin, and the outer one partly enclosing the others so that it forms ⅔ the greater diameter of shell. Whorls 5, visible on both sides, the rounded (or right) surface showing less of them than the other. Left (or umbilical?) surface nearly flat, deeply concave near middle, the umbilicus being over ⅓ of diameter. Mouth trapezoidal, very oblique, its lips curved, the right extremity attached near the concave spire, the left to the obtuse periphery of shell. Mouth ⅓ longer than wide; its breadth over ⅓ of that of shell. Greater diameter 0.16, least 0.05 inch. Color brown, surface smooth.

Habitat.—With *P. anitensis*, in same laguna. This shell might, at first sight, pass for the young or a stunted form of the preceding, but it seems to present essential differences too marked to allow of such an inference. Like that it appears to be sinistral but it is impossible to decide which is the umbilical side with certainty. It is also one of the puzzling intermediate forms of the Planorboid group, and belongs as much to Menetus as to Anisus, with some resemblance to Nautilina. It bears much the relation to typical Planorbis that Gonostoma, etc., do to other Helicoids, and if found on dry ground might easily have been taken for a terrestrial shell. No northern species resembles it much.

HELICODISCUS LINEATUS SONORENSIS n. subsp. Plate xiv, fig. 10.

The little shell here figured was found by Dr. Eisen in a damp locality near San Miguel, Sonora, Mexico, and supposed at first to be the young of a Planorboid aquatic shell, but the microscope proved it to be probably a young shell of Say's species, or perhaps a regional subspecies to which I have given the above provisional name. The figure 10*a* would prove its immaturity if it did not have a slightly thickened lip, there being but three whorls visible and no teeth. *H. lineatus* is one of the most widely spread species of North America, from New Brunswick, latitude 49°, to Montana, and Georgia to California, but with varieties or subspecies having different characters. That of Sonora may, when found mature, add another form, but this specimen seems only about half grown.

It differs from *lineatus* in the subangled margin, smaller umbilicus, more rapidly enlarging whorls, and no denticles. The Californian subspecies is also without denticles. It is barely possible that a new Planorbis may occur in Mexico having these characters, but none is known elsewhere with bands beneath the epidermis. I have compared it with Gould's *P. hirsutus* (*P. albus* Muller *var.?*). This resembles the Sonora shell in having similar lines in the epidermis, but they produce rows of bristles which fall off easily with the skin, leaving no marks. It is also one-fifth larger than *H. lineatus* and has only 3 whorls when full grown.

It is somewhat singular that Say, the author of the species, made the mistake of describing a specimen as a Planorbis. It was found "in a dried up pond with a number of aquatic shells in the Upper Missouri region." He called it *P. parallelus*, and, although three times as large as the Sonora specimen, he did not suspect its true character, though he thought it "might be a land-shell," it probably having been faded and the internal denticles absent. (See Binney's Ed. of Say's Works, pp. 9, 11, 63, and his Land and Fresh Water Shells, part 2, p. 135.) There is certainly a close resemblance in this land-shell to the toothed Planorbes of the subgenus *Segmentina*, but none of them is described as having colored lines as this has.

Dr. Eisen also found in Sonora a *Bulimulus* apparently a small variety of *B. alternatus* Say, a widely spread species of Mexico and Texas, very abundant at Hermosillo. One *Helix behri* Gabb at Guaymas, and *Patula mazatlanica* Pfeiffer, north of Mazatlan—5 or 6 dead. *Hyalinia indentata* Say, is another Sonoran species, named in the previous article, p. 216. Also, *Limax* (sp. indet.)

EXPLANATION OF PLATES XIII, XIV.

Fig. 1*a*, Columna ramentosa × about 4. 1*b*, Showing folds of anterior whorl and narrowed 2d whorl. 1*c*, Lateral view of same. 1*d*, Apical whorls, the 2 nuclear with vertical, and 2 next with oblique ribs becoming ramentose on third. 1*e*, 1*f*, More magnified figures of sculpture of four apical whorls.

Fig. 2*a*, Columna (var.?) abbreviata × about 3. 2*b*, 2*c*, as in 1*b*, 1*c*. 2d nuclear and 3d whorls.

Fig. 3*a*, Melaniella eiseniana × nearly 9. 3*b*, Rib sculpture of all the whorls. 3*c*, Apical whorls, the 3d narrowed.

Fig. 4*a*, *b*, Bulimulus inscendens bryanti enlarged. 4*c*, Nuclear whorls.

Fig. 5*a*, *b*, Bulimulus inscendens beldingi enlarged nearly ½. 5*c*, Rib sculpture of apical whorls.

Fig. 6*a*, *b*, Bulimulus sufflatus insularis enlarged ½.

Fig. 7*a*, 7*b*, Helix areolata exanimata, plain and banded examples, a little enlarged.

Fig. 8*a*, *b*, Planorbis (Anisus) anitensis × 10.

Fig. 9*a*, *b*, Planorbis (Anisus?) peninsularis × about 10.

Fig. 10*a*, *b*, *c*, Helicodiscus lineatus sonorensis × 14. 10*d*, Revolving lines more magnified, crossed by lines of growth.

DESCRIPTION OF A NEW KANGAROO RAT FROM LOWER CALIFORNIA (DIPODOMYS MERRIAMI MELANURUS subsp. nov.) COLLECTED BY WALTER E. BRYANT.

BY C. HART MERRIAM.

In an interesting collection of mammals from the Cape region of Lower California, sent me for examination by Mr. Walter E. Bryant, is an undescribed kangaroo rat which Mr. Bryant has kindly asked me to name.

It is a small 4-toed form closely related to *Dipodomys merriami* Mearns (from New River, Arizona), with which it doubtless intergrades and from which it differs chiefly in having the terminal third of the tail abruptly blackish. The very large series of *D. merriami* in the U. S. Department of Agriculture collection (comprising upwards of 600 specimens) shows that the distal part of the tail becomes darker in passing southward from Arizona and southern California through Sonora, and that specimens from Ortiz and Guaymas are almost identical with those from the Cape region of the peninsula.

The new form may be known from the following description:

Dipodomys merriami melanurus subsp. nov.

Type No. 539 ♂ ad. Collection of California Academy of Sciences. From San José del Cabo, Lower California, March 19, 1892. Collected by Walter E. Bryant. Original number, 551.

Measurements of type (taken in flesh by collector).— Total length, 239; tail vertebræ, 144; hind foot, 35. Average measurements of six specimens from type locality (San José del Cabo): Total length, 240; tail vertebræ, 141; hind foot, 36.5.

General characters.—Similar to *D. merriami*, but smaller; terminal third of tail abruptly blackish.

Color.—Upper parts pale ochraceous-buff mixed rather sparingly with black-tipped hairs; crescents at base of whiskers small; face and supraorbital spot white; not dusky on ankle; upper and lower tail-stripes continuous to tip, meeting considerably anterior to end of vertebræ, the crested penicillate part blackish.

PROCEEDINGS.

January 20, 1890.—Stated Meeting.

The President in the chair.

Donations to the Museum were reported from John Crellin and Maurice Chaper.

Additions to Library:

From correspondents	56
By purchase	5
By donation	77

Dr. Harkness spoke on the injury done to oysters planted in the bay by whelks, which were probably introduced with them.

Dr. Behr made some remarks on the fish and crustacea, found in artesian wells in Algeria, donated by Maurice Chaper. Dr. Eisen stated that similar fish were found in artesian wells in Kern County.

Dr. Behr presented specimens of diseased peach roots and the President called attention to a recent report on the root-knot disease, published by the Department of Agriculture, wherein it is claimed that the disease is the work of Anguillula. In the discussion which followed, this theory was repudiated by Dr. Harkness and Dr. Behr, they claiming that the Anguillula does not produce the disease, but finds in the diseased tissue a suitable nidus.

February 3, 1890.—Stated Meeting.

The President in the chair.

Donations to the Museum were reported from Charles H. Ohm, W. S. Bliss and W. D. Bliss.

Additions to Library:

From correspondents	69
By purchase	5

February 17, 1890.—Stated Meeting.

The President in the chair.

Frank H. Vaslit and James S. Bunnell were elected resident members.

Carl H. Eigenmann and Charles Fuchs were proposed for membership.

Donations to the Museum were reported from Dr. Toland, Carl Precht, T. S. Brandegee, C. A. Hamilton, Charles H. Ohm and J. L. O. Hamilton.

Additions to Library:

From correspondents	138
By purchase	13

Dr. H. H. Behr read a paper on Amblystoma.

Capt. I. E. Thayer read a paper on modern ship building.

The President called attention to the death of Ernest St. C. Cosson, of Paris, an honorary member, and read a sketch of his life and labors.

March 3, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from Henry C. Wulf and Robt. A. A. Wright.

Additions to Library:

From correspondents	46
By purchase	3
By donation	1

The following paper was read by title:

Notes on Sub-Alpine Mollusca of the Sierra Nevada, by W. J. Raymond.

Mr. Gutzkow exhibited a specimen of Cordyceps, and Dr. Behr and Dr. Harkness made some remarks upon its life history.

Mr. Hittell read the following notice:

"Ernest Cosson, honorary member of this society, died, at the age of 70 years, at his residence in Paris, on the last day of 1889. A man of generous disposition and in easy circumstances, he early turned his attention to botany. Well known in France as the author of local botanical works, he is best known abroad by his connection with the exploration of Algiers, to the botany of which he devoted the last forty years of his life, and which, delayed by his conscientious care, remains unfortunately unfinished. He was elected a member of this society in 1887, and testified his interest in our welfare by sending us publications and a large collection of Algerian plants, and when overtaken by his last illness, was preparing to send us a second installment. His death is a severe loss to science and to all connected with him."

T. S. BRANDEGEE,
T. H. HITTELL,
Committee.

March 7, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from George B. Badger, Harry R. Taylor, B. C. Winston, Clark P. Streator, L. Belding and Charles H. Ohm.

Additions to Library:

From correspondents	106
By purchase	7
By donation	4

Dr. H. W. Harkness read a paper on The Nomenclature of Organic Life.

Mr. August Ehrlich, of Kaweah, Tulare County, presented specimens of the sclerotia of a species of Polyporus.

Dr. Harkness made some remarks on *Rhytisma arbuti*, a fungus infesting the leaves of the Madroño.

April 7, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from Mrs. Charles A. Morse, Walter E. Bryant, Charles H. Ohm, F. O. Johnson, Dr. H. H. Behr, E. M. Cooper, Walter D. Bliss and D. S. Bryant.

Additions to Library:

From correspondents	154
By purchase	9
By donation	3

Carl H. Eigenmann read a paper on Some Features of the Fresh-water Fauna of South America.

Dr. H. Carrington Bolton gave an account of his visit to the bank of sonorous sand in the Desert of Sinai.

Prof. Henry A. Ward, who had visited the same hill more than thirty years before, gave an account of his experiences during the journey. He then related the story of his recent trip through the inland passage, which extends from latitude 42° south for more than a thousand miles along the west coast of South America.

April 21, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Robert Stevenson was proposed for membership.

Donations to the Museum were reported from Melville Attwood and Carl H. Clark.

Additions to Library:

From correspondents	63
By purchase	16
By donation	1

Several specimens of Coprinus of extraordinary size were presented by

Mr Carl H. Clark. The largest was over six inches in breadth, with a stripe an inch in diameter and sixteen inches in length.

C. H. Eigenmann spoke on the young of the Quinnat salmon and of *Osmerus thaleichthys*; also on some new species of Scopelidæ.

May 5, 1890.—Stated Meeting.

Vice-President Behr in the chair.

Carl H. Eigenmann and Charles Fuchs were elected resident members.

Donations to the Museum were reported from Charles H. Ohm, Carlos Troyer, W. Otto Emerson, W. D. Bliss, Charles A. Keeler and W. W. Price.

Additions to Library:

From correspondents	106
By donation	20
By purchase	5

May 19, 1890.—Stated Meeting.

The President in the chair.

Charles A. Keeler was proposed for membership.

Additions to Library:

From correspondents	70
By purchase	7
By donation	2

F. Gutzkow communicated the results of his examination of the deposits of pyrolusite within the city limits.

Carl H. Eigenmann spoke on the development of the membranes in the eggs of fishes.

June 2, 1890.—Stated Meeting.

The President in the chair.

W. W. Price was proposed for membership.

Donations to the Museum were reported from L. Belding, E. D. Flint, Charles H. Ohm and T. S. Brandegee.

Additions to Library:

From correspondents	141
By purchase	5
By donation	2

T. S. Brandegee gave an account of his recent trip to Santa Catalina Island.

June 16, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Dr. H. Carrington Bolton exhibited a quantity of sonorous sand procured on his late visit to the Hawaiian Islands, and produced from it the characteristic sound.

Dr. Carl Lumholtz gave a lecture on his two years' residence among the cannibals of Australia, profusely illustrated.

July 7, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from William Barber, Mrs. C. W. Knox, L. Belding, Wm. M. Willey, E. D. Flint, James L. Ord and Melville Attwood.

Additions to Library:

From correspondents	156
By purchase	25
By donation	4

F. Gutzkow spoke on a diatomaceous earth from Sonoma County.

C. H. Eigenmann exhibited specimens of salmon, salmon trout and trout, and spoke on the differences between the species.

July 21, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Additions to Library:

From correspondents	113
By purchase	12
By donation	2

G. P. Rixford presented specimens of marble from Inyo County and of carbonate of soda from the soda works at Owens Lake, giving a description of the process of manufacture.

I. E. Thayer announced the donation of five cases of corals, thirty-seven species, from the Navigator Islands, by Thomas C. Johnston. The thanks of the Academy were voted to Mr. Johnston.

Dr. H. Carrington Bolton spoke concerning the coming meeting of the American Association for the Advancement of Science.

August 4, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Robert Stevenson, Charles A. Keeler, and W. W. Price were elected resident members.

Donations to the museum were reported from W. A. Robbins, Walter E. Bryant, A. K. P. Harmon, Charles A. Keeler, Capt. T. D. Shid and Melville Attwood.

Additions to Library:

From correspondents	55
By purchase	19

Rosa S. Eigenmann made some remarks on a shark presented by Capt. Shid.

Walter E. Bryant spoke on the geographical distribution of some species of Tamias.

Dr. Gustav Eisen gave an alarming description of the destruction and waste of many of the grandest Sequoias in certain localities of the Sierra Nevada, and pointed out the necessity of immediate action on the part of the Academy in petitioning the government at Washington to permanently protect these forests.

W. S. Chapman, J. R. Scupham and Gustav Eisen were appointed a committee to draft resolutions to be presented to the government.

August 18, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the museum were reported from I. E. Thayer, A. V. La Motte, L. Belding, A. W. Anthony, S. T. Dodson, W. D. Bliss and J. W. Morrison.

Additions to Library:

From correspondents	91
By purchase	8
By donation	3

Rosa S. Eigenmann read a paper on the establishment of a marine laboratory in California.

A paper written by Dr. Edward Palmer on the customs of the Coyotero Apaches was read.

Dr. Gustav Eisen read the memorial prepared by the Committee on the Preservation of the Big Trees, and it was approved by the Academy.

September 1, 1890.—Stated Meeting.

The President in the chair.

Additions to the Library:

From correspondents	105
By donation	35
By purchase	6

A complete set of the Zoological Record was presented by Mr. Prosper Huerne, to whom the thanks of the Academy were voted.

Dr. Behr made some remarks on the caprification of the fig.

A paper by Frank J. Walker, on the location and area of Sequoia forests was read, and it was voted that a copy with maps be sent to the Secretary of the Interior and to members of Congress.

The Report of the Committee on Sequoia Park was read by Dr. Eisen, accepted, and copies ordered to be sent to Congress.

Memorial on Adley H. Cummings was read by Mr. Holladay, and a copy ordered sent to the family of the deceased.

Amendment to the Constitution of the Academy creating a class of associate membership and restricting the admission of voting members to scientists was offered, accepted by votes of the members present and referred to the Council.

September 15, 1890.—Stated Meeting.

The President in the chair.

Donations to the Museum were reported from Walter D. Bliss and A. K. P. Harmon.

Additions to Library:

From correspondents	56
By purchase	5

A paper by Mrs. T. H. Hittell on Indian Pictographs or Painted Stones was read, and photographs exhibited of several of the most striking examples.

Charles A. Keeler read some notes and exhibited a map showing the limited area now occupied on this coast by the English sparrow and urged its extermination before it is too late.

October 6, 1890.—Stated Meeting.

Vice-President Behr in the chair.

F. C. von Petersdorff was proposed for membership.

Donations to the Museum were reported from T. S. Brandegee.

Additions to Library:

From correspondents	145
By donation	138
By purchase	18

The proposed amendment to the Constitution was adopted, to be finally voted upon at the annual meeting.

October 20, 1890.—STATED MEETING.

The PRESIDENT in the chair.

Dr. Geo. M. Sternberg was proposed for membership.

Donations to the Museum were reported from Henry Hemphill.

Additions to Library:

From correspondents	151
By purchase	12
By donation	1

Charles A. Keeler read a paper on the Geographical Distribution of Land Birds in California.

The President announced the death of Capt. R. S. Floyd, and James T. Boyd, Thomas P. Madden and Ralph C. Harrison were appointed a committee to prepare suitable resolutions.

November 17, 1890.—STATED MEETING.

The PRESIDENT in the chair.

George M. Sternberg was elected a resident member.

Additions to Library:

From correspondents	151
By purchase	12
By donation	2

Mr. James T. Boyd read the following report:

To the California Academy of Sciences:

The undersigned committee appointed on Monday evening, October 20, 1890, to prepare resolutions expressive of the feelings of the members in respect of Captain R. S. Floyd, deceased, herewith submit the following:

JAMES T. BOYD,
RALPH C. HARRISON,
THOS. P. MADDEN,
Committee.

Resolved, That his fellow-members of the California Academy of Sciences have heard with profound sorrow of the death of Captain Richard S.

Floyd, a member of this society, and President of the James Lick Trust, in which trust this society is largely interested.

Resolved, That in his death this society has lost a valued member and the community an honorable, intelligent and public spirited citizen.

Resolved, That this society recognizes with pride the valuable services to science rendered by him in his devoted, intelligent, untiring and successful efforts to carry out the wishes of its benefactor, James Lick, in the construction of the great telescope and in the erection of the observatory upon the summit of Mount Hamilton so munificently provided for in his deed of trust.

Resolved, That while we thus recognize his services to our State and to mankind we cannot but feel that in this his crowning life-work, he became a martyr to his sense of duty and that his early death was in great measure due to his devotion to the sciences he loved so well.

Resolved, That to the faithful and intelligent administration of the trusts imposed upon them by Mr. Lick, by the Board of Trustees, of which the deceased was president, is this society largely indebted for its present excellent financial position.

Resolved, That we offer to the bereaved family our most sincere condolence in their and our common affliction.

Resolved, That a copy of these resolutions properly engrossed and mounted be presented to the widow of the deceased.

Resolved, That these resolutions be spread upon the journal of this society.

Walter E. Bryant and T. S. Brandegee, made verbal reports on their trip to the Cape Region of Lower California.

December 1, 1890.—Stated Meeting.

The President in the chair.

Lieutenant John P. Finley, U. S. A., read a paper on Cyclonic Development and Precipitation upon the Pacific Coast.

A vote of thanks was passed to Lieutenant Finley.

December 15, 1890.—Stated Meeting.

The President in the chair.

Donations to the museum were reported from Dr. Joseph Pescia, Charles N. Comstock, Dr. H. H. Behr, Charles H. Townsend and Walter E. Bryant.

Additions to Library:

From correspondents	188
By purchase	15
By donation	2

The President announced the death of Dr. Henry Ferrer, and, on motion, Dr. C. M. Richter and Dr. E. S. Clark were appointed a committee to draft resolutions of respect and condolence.

The death was also announced of Dr. J. B. Trembley, and J. R. Scupham and Arthur Brown were appointed to draft appropriate resolutions.

The report of the Nominating Committee was read naming the following ticket:

For *President*, H. W. Harkness.
First Vice-President, H H. Behr.
Second Vice-President, George Hewston.
Corresponding Secretary, F. Gutzkow.
Recording Secretary, J. R. Scupham.
Treasurer, L. H. Foote.
Librarian, Carlos Troyer.
Director of Museum, J. G. Cooper.
Trustees, W. C. Burnett, C. F. Crocker, D. E. Hayes, E. J. Molera, Geo. C. Perkins, Irving M. Scott, John Taylor.

Some remarks were made by Walter E. Bryant, on a kind of fire sticks used by the natives of Lower California, and also on the peculiar tendency of the small skunk of that region to be afflicted with rabies and to attack man.

January, 5, 1891.—Annual Meeting.

The President in the chair.

The annual reports of the Officers and Board of Trustees were read and ordered filed.

The judges and inspectors of election reported the following as the result of the annual election:

H. W. Harkness, *President.*
H. H. Behr, *First Vice-President.*
George Hewston, *Second Vice-President.*
Frederick Gutzkow, *Corresponding Secretary.*
J. R. Scupham, *Recording Secretary.*
L. H. Foote, *Treasurer.*
Carlos Troyer, *Librarian.*
J. G. Cooper, *Director of Museum.*

The amendment adopted.

ADDITIONS TO THE MUSEUM FOR THE YEAR 1890.

Unless otherwise stated, the following accessions to the collections have been received by donation:

A. W. Anthony, San Diego, Cal.: 3 mammals in alcohol.

Melville Attwood, San Francisco: 1 specimen each of Stibnite and Stibiconite, and fossils from Plumas county.

George B. Badger, Haywards, Cal.: skins with crania of 1 *Lepus sylvaticus auduboni*, 2 *Spermophilus grammurus beecheyi* and 1 *Neotoma fuscipes*.

William Barber, San Francisco: 1 specimen of scorpion, alive.

Dr. H. H. Behr, San Francisco: 1 *Scapanus townsendi* and 1 Australian marsupial in flesh; 20 specimens Lepidoptera.

L. Belding, Stockton, Cal.: 1 mammal in alcohol; skins of *Chen hyperborea nivalis* and 14 other birds' skins; 10 specimens in flesh.

Walter D. Bliss, Carson City, Nev.: 24 mammals in alcohol, 2 in flesh; 1 specimen in flesh of *Chamæa fasciata*, from San Mateo county.

Will S. Bliss, Carson City, Nev.: 5 mammals in alcohol, 1 in flesh.

T. S. Brandegee, San Francisco: 14 specimens Coleoptera, and 4 shells from Baja California.

D. S. Bryant, Healdsburg, Cal.: 3 adult and 4 young *Arvicola* in flesh, also 3 nests of same; 16 specimens of birds in flesh.

Walter E. Bryant, Curator: 29 specimens mammals in flesh; 25 specimens birds in flesh, 18 skins, 4 skeletons; 16 specimens (two species) fresh water shells; 7 specimens fresh water leeches; 1 lizard in alcohol; nest and 4 eggs of *Vireo huttoni*.

Maurice Chaper, Paris, France: 52 specimens fish and crustacea found in an artesian well in the environs of Barna, Algiers.

Charles N. Comstock, Oakland, Cal.: 1 *Bubo virginianus subarcticus* in flesh.

John Crellin, San Francisco: 9 specimens *Purpura crispata* and 3 specimens Ostrea.

S. T. Dodson, Temescal, Cal.: 1 *Wenona plumbea* alive.

W. Otto Emerson, Haywards, Cal.: 1 cranium of rodent; 16 specimens avian osteology.

E. D. Flint, Oakland, Cal.: 1 *Scapanus townsendi* in flesh and 1 cranium of same.

C. A. Hamilton (through *H. S. Durden*): collection of insects and reptiles from Mexico.

J. L. O. Hamilton, San Francisco: fossil molar of *Elephas primigenius*.

A. K. P. Harmon, Oakland, Cal.: 1 *Thomomys talpoides bulbivorous* in flesh; specimen of wood compressed in Consolidated Virginia Mine.

Henry Hemphill, San Diego, Cal.: collection of land and marine shells.

F. O. Johnson, Oakland, Cal.: 1 *Scapanus townsendi* in flesh.

Thomas C. Johnston, San Francisco; 5 cases of corals (37 species) from the Navigator Islands.

Charles A. Keeler, Berkeley, Cal.: collection of 514 skins of North American birds; 50 insects, principally Coleoptera; collection of several hundred eggs and nests.

Charles W. Knox, Oakland, Cal.: 1 *Urinator lumme* in flesh.

Mrs. C. W. Knox, Oakland, Cal.: 1 *Carduelis canaria* in first plumage.

Lower California Expedition of 1890: 62 skins, 44 alcoholic specimens, 61 crania of mammals; 183 specimens of birds, 2 birds' sterna, 3 nests and 5 eggs; 75 reptiles; 6 batrachians; 34 fishes; 1,000 insects; 25 crustaceans; 2 specimens fungi; 2 osteological specimens and remains of 3 Indians; 168 land and fresh-water shells; 11 marine shells; 12 geological specimens; 7 miscellaneous.

B. Macdonald, San Francisco: 1 *Spermophilus grammurus beecheyi* in flesh; 3 *Junco hyemalis oregonus*, 1 *Regulus calendula* in flesh.

Captain George Miller, San Jose del Cabo, Mexico: 1 specimen *Hippocampus hudsonius*.

J. W. Morrison, Lakeport, Cal.: 1 *Crotalus* sp. ?.

Mrs. Charles A. Morse, San Francisco: 6 birds' skins from Mare Island, Cal.

Charles H. Ohm, San Francisco: 1 cranium of *Thalassarctos maritimus;* 1 specimen of Madrepore.

James L. Ord, Arizona: 1 *Heloderma suspectum*.

Dr. Joseph Pescia, San Francisco: 1 cranium of *Thalassarctos maritimus*.

F. H. Pratt, Alameda, Cal.: 1 specimen of water-worn coral.

Carl Precht, San Francisco: collection of fungi.

W. W. Price, Oakland, Cal.: 1 lizard in alcohol.

W. A. Robbins, San Francisco: nest and two eggs of *Geothlypis trichas occidentalis*.

Clark P. Streator, San Francisco: skins of 4 *Fulmarus glacialis glupischa*, 1 *Oidemia deglandi*, 1 *Æchmophorus occidentalis*.

H. R. Taylor, Alameda, Cal.: skin of *Mephitis mephitica*.

Captain I. E. Thayer, San Francisco: specimen of hymenopterous insect (foreign).

Dr. Charles Toland, San Francisco: specimen *Amblystoma macrodactylum*.

Charles H. Townsend, U. S. F. C. S. Albatross: 5 birds' skins from Alaska and California.

Carlos Troyer, San Francisco: specimen *Eutainia* sp. ?

William M. Willey, San Francisco: 1 abnormal egg of domestic fowl.

B. C. Winston, Monterey, Cal.: 1 *Didelphys virginiana*, juv., 2 monkeys and 1 Australian rat in flesh.

R. E. Wood, Rutherford, Cal.: 1 specimen in flesh of *Regulus satrapa olivaceus*.

R. A. A. Wright, San Francisco: specimen *Hippocampus hudsonius*.

Henry C. Wulf, San Francisco, 4 specimens *Placuanomia* sp.?

Purchased: 7 specimens mammals in flesh.

February 2, 1891.—Stated Meeting.

The President in the chair.

Additions to Library:

From correspondents	141
By purchase	19
By donation	6

Dr. C. M. Richter, of the committee to draft resolutions on the death of Dr. Ferrer, presented the following report:

"It is with deep sorrow that we are called upon to chronicle the death of one of our most distinguished members, Dr. Henry Ferrer. He was one of the foremost standard bearers of science on the Pacific Coast. He had not only attained a position of great eminence in his profession, a world-wide reputation in his specialty; he was not only the most skillful master in microscopy, inferior to no one in its technique and application, but he was a warm promotor of science generally, one whose devotion to science will ever be gratefully remembered by the members of this Academy."

Your committee therefore recommend the following resolution:

Resolved, That the foregoing memorial of the late Dr. Henry Ferrer, member of the California Academy of Sciences, be placed in full on the minutes as a token of the estimation in which he was held by this Academy, and a copy thereof be forwarded to his widow and family.

A committee consisting of Charles A. Keeler, Walter E. Bryant, and J. R. Scupham, was appointed to memorialize the Legislature to take some steps to prevent the spread of the English Sparrow.

March 2, 1891.—Stated Meeting.

The President in the chair.

F. C. von Petersdorff, was elected a resident member.

Donations to the museum were reported from L. Belding, Robt. A. A. Wright, Walter E. Bryant, M. Braverman, B. C. Winston, Geo. W. Dunn and Melville Attwood.

Additions to Library:

From correspondents	123
By purchase	15
By donation	2

Dr. H. H. Behr read a paper on Botanical Reminiscences.

Walter E. Bryant read a paper entitled, A Provisional List of the Land Mamals of California.

The secretary read an account of the discovery of precious opals near Moscow, State of Washington, and exhibited specimens in the matrix, presented by Melville Attwood.

The following communication was read:

San Francisco, March 2, 1891.

To the Officers and Members of the California Academy of Sciences:

I hereby present to this Academy my collection of Fungi, now in this building, in the gathering and identification of which I have devoted the major portion of my time during the past fifteen years. The collection consists of between 10,000 and 11,000 numbers, which are catalogued by the card system, nearly 13,000 separate cards having been required for the work.

The catalogue has been arranged for immediate use and the specimens are already in convenient receptacles.

Yours respectfully,

H. W. HARKNESS.

A vote of thanks was unanimously tendered to Dr. Harkness for his valuable gift.

May 4, 1891.—Stated Meeting.

The President in the chair.

David S. Jordan, Charles H. Gilbert, Oliver P. Jenkins, Douglas H. Campbell, John C. Branner, Joseph Swain, George M. Richardson, Charles D. Marx, Horace B. Gale and Fernando Sanford, were proposed for membership.

Donations to the museum were reported from Frank H. Vaslit, B. C. Winston, Walter E. Bryant, J. H. Barr, G. P. Rixford, Dr. H. H. Behr, Robert Moses, H. S. Nichols, William A. Robbins and L. Belding.

Additions to Library:

From correspondents	322
By purchase	33
By donation	18

G. P. Rixford read a paper on Indian carvings at Swansea, Inyo County, and presented a series of photographs of the carvings.

E. J. Molera announced the recent death of General Carlos Ibañez, Count of Mulhacen, President of the International Geodetical and Statistical Societies and President of the International Board of Weights and Measures, and read a notice of his life and works.

Professor Carl Lumholtz read a paper on his recent explorations in Mexico, giving his experiences and discoveries in the hitherto unexplored Sierra Madre country.

On motion, a vote of thanks was tendered to Mr. Lumholtz for his interesting paper.

The President announced the death of Professor John LeConte, and Mr. T. H. Hittell and General J. F. Houghton were appointed a committee to draft resolutions of respect and condolence.

June 1, 1891.—Stated Meeting.

The President in the chair.

Donations to the Museum were reported from William Ryan, Walter E. Bryant, Mrs. J. Lawley, Adolph T. W. Erzgraber, Dr. J. G. Cooper, J. G. Chalker, Miss Alice Eastwood, Dr. E. S. Clark, Mrs. R. A. A. Wright.

Additions to Library:

From correspondents	144
By donation	284
By purchase	15

The thanks of the Academy were voted to Dr. Gustav Eisen for his donation of 279 books and pamphlets on Geology, Zoology, Anatomy and Botany.

Lieutenant John P. Finley read a paper on the Hot Winds of California, illustrated with numerous maps and charts.

Specimens of opals in the matrix from Mexico, Australia and Hungary, presented by Melville Attwood, were exhibited, and a short paper on opals by Mr. Attwood was read.

The following memorial of Professor John LeConte was read by Mr. T. H. Hittell:

A great and honored member of this Academy has passed away from amongst us, a man loved by all who knew him for the kindness and geniality of his disposition, revered for the elevation and purity of his character, and eminent for the breadth and depth of his scientific and scholarly attainments.

Professor John LeConte, of the University of California, closed his long and honorable career at Berkeley on April 29, 1891. He was born in Liberty County, Georgia, on December 4, 1818, and was consequently seventy-two years and a few months old at the time of his death. He received a preparatory training under the tuition of the celebrated Alexander H. Stephens, and in 1835 entered Franklin College, afterwards known as the University of Georgia, where he graduated with high honors in 1838.

From an early age he manifested a remarkable taste for scientific subjects, and in college exhibited a decided preference for those branches of study which were connected with nature and physics. Almost immediately after graduation he proceeded northward; entered the College of Physicians and Surgeons of the University of New York, and received from that institution the degree of M. D. in March, 1841. He then returned to his native State and married a lady of beauty and refinement, who survives him as his widow. He commenced the practice of medicine at Savannah, where he remained until August, 1846, when he was elected to the chair of natural philosophy and chemistry in Franklin College, his alma mater. From that time he abandoned the practice of medicine and devoted himself to the study of the physical sciences. In 1855 he became lecturer on chemistry in the College of Physicians and Surgeons in the University of New York, thus reaching a chair in his second alma mater as he had previously reached a chair in his first.

In 1856 he accepted a call to fill the professorship of natural and mechanical philosophy in the University of South Carolina, and remained their until the spring of 1869, when he was called to the chair of physics in our own University of California. He was almost immediately upon his arrival in this State appointed acting President of the University, and as such initiated the first exercises of that institution. In 1870, after the election of Dr. Durant as President, and for several years thereafter, Dr. Le Conte gave himself up exclusively to the duties connected with his professorship, but in 1875, after the resignation of Dr. Gilman, he was again appointed to act as President, and in 1876, was elected to the office of President. He continued to fill the office of President for a year and a half, since which time, and to the time of his death he occupied the chair of physics.

Professor Le Conte became a member of this Academy on August 3, 1870, and a life member on January 3, 1888. He was also a member of the National Academy of Sciences and of many other scientific societies in this country and in Europe. He wrote many valuable and important papers on scientific subjects and particularly on subjects connected with the phenomena of the vibrations of sound, on the astronomy of Mars and its satellites, on the famous nebular hypothesis, on the evolution of worlds, and on various other matters whereby glimpses are gained into that world of truth called nature, the knowledge of which is destined to emancipate humanity from the shackles of ignorance and superstition, and all the innumerable ills connected with and involved in those immeasurable evils.

About the end of the last century, the German philosopher Fichte wrote a treatise on the subject of The Scholar, in which he represented the avocation of the genuine student of truth as the grandest and sublimest occupation of the human mind. In perusing his book the reader by degrees becomes almost as enthusiastic as the writer was, and feels in every part of his sensitive system the verity of what the philosopher set forth.

The glories of conquest and empire, the pride of kings, presidents and politicians, the glamour of family and wealth all pass away. They are vanities. They are nothing. But what the scholar accomplishes endures and advances the race in the path of civilization and culture. In these days, quite as certainly as a hundred years ago, there is no greater man than the scholar, and among the scholars of California, no one, perhaps, made a nearer approach to the character contemplated by the philosopher than our late honored member, Professor John Le Conte.

THEODORE H. HITTEL,
JOHN F. HOUGHTON.

July 6, 1891.—Stated Meeting.

The President in the chair.

Donations to the Museum were reported from L. Belding, W. S. Bliss, Walter E. Bryant, Miss Alice Eastwood, W. J. Golcher and R. C. McGregor.

Additions to Library:

From correspondents	100
By purchase	21
By donation	8

The President announced the death of Henry Edwards, Chas. Stephens, E. J. de Santa Marina, members.

Dr. David Wooster read a paper on Stone Heaps in Arizona.

Dr. H. H. Behr read a paper on a New Remedy for Snake Bites,

August 3, 1891.—Stated Meeting.

T. H. Hittell in the chair.

Edward Ehrhorn was proposed for membership.

Specimens of coal and coke from the Tacoma Colliery, Wilkeson Coal Field, Washington, were presented by Mellville Attwood, and a paper by him on the subject was read.

Dr. Gustav Eisen read a paper on the introduction of *Blastophaga psenes* into California, giving a complete description of the caprification of the fig.

September 7, 1891.—STATED MEETING.

The PRESIDENT in the chair.

David S. Jordan and Joseph Swain were proposed for membership.

Donations to the Museum were reported from B. Macdonald, W. M. Willey, C. W. Knox, Gustav Eisen, J. B. McChesney, Mrs. S. E. Vaslit, M. Braverman, Frank H. Vaslit, Ramon E. Wilson, Dr. W. Allen, H. H. Ellis, Charles Fuchs, Geo. B. Badger, Leland Stanford, Mrs. H. B. Wilson, N. Ahrens, W. A. Bissell, D. C. Stone, Walter E. Bryant, R. C. McGregor, E. D. Flint, W. H. Shockley and California Fish Commission.

Additions to Library:

From correspondents	347
By purchase	56
By donation	156

The President announced the death of the Second Vice-President, Dr. George Hewston, and T. H. Hittell, Dr. H. H. Behr and J. R. Scupham were appointed a committee to prepare resolutions of respect and condolence.

The death of Henry Edwards was announced and Walter E. Bryant, Frank H. Vaslit and H. W. Harkness were appointed to draft suitable resolutions.

October 5, 1891.—STATED MEETING.

The PRESIDENT in the chair.

Charles H. Gilbert, Douglas H. Campbell, Edward Ehrhorn, David S. Jordan and Joseph Swain were elected resident members.

William E. Ritter was proposed for membership.

Donations to the museum were reported from C. H. Lewis, C. W. Knox, Carlos Troyer, F. W. Bancroft, L. Belding, Charles A. Keeler, Walter E. Bryant, F. O. Johnson, A. V. La Motte, Walter D. Bliss, Charles H. Townsend, Stewart McClure, Mrs. Dan Patten and J. T. Hill.

Additions to Library:

From correspondents	177
By purchase	18
By donation	3

Mr. T. H. Hittell read the following report:

MR. PRESIDENT: Your Committee appointed at the last meeting to prepare a paper expressive of the sense of the Academy upon the death of Dr. George Hewston, late Life Member and Vice-President, beg leave to submit the following:

Dr. George Hewston, an honored member of this Academy, who, for nearly thirty years, was actively engaged in encouraging its objects and promoting its interests, has passed away. He was born in Philadelphia, Pennsylvania, on September 11, 1826, and it was there too that he was reared and received his early education. Naturally studious and interested in scientific subjects, he turned his attention to medicine and, after a regular course of study, was graduated an M. D. from the University of Pennsylvania. After practicing a few years in his native city, during a part of which time he was Professor of Anatomy in the Philadelphia College of Medicine, he, in 1860, came to California, and being pleased with the country and climate, in 1861 brought out his family and, opening an office for the practice of his profession, took up his permanent residence in San Francisco.

His main leaning, outside of his profession, was towards zoology and particularly the study of zoophytes; but he also from time to time manifested lively interest in politics and in 1873, was elected to the Board of Supervisors and in 1875, upon the death of James Otis, Mayor of the City and County of San Francisco, was chosen to fill his unexpired term, which he did with credit to himself and satisfaction to the public. He also for a number of years occupied the position of Professor of the Theory and Practice of Medicine in the Toland Medical College and afterwards in the Medical Department of the University of California.

He became a member of this Academy on March 17, 1862, and on March 1, 1869, a life member, and was at the time of his death on September 4' 1891, and had been for several years previously, Vice-President. He was a fluent speaker and a ready writer of elegant English. Besides numerous written leetures on scientific and literary subjects, he gave frequent oral addresses before this Academy on matters of general interest and was always listened to with attention, appreciation and applause. He was a man of pleasing and attractive presence; and the work he did and the impression he produced upon his cotemporaries were those of an earnest student and scholar, a good citizen, an honor to his profession and a devoted friend to science.

In view of the death of so prominent a man and member of this Academy and as a fiting token of respect to his memory

Resolved, That the foregoing sketch of the late Vice-President Hewston be spread upon the minutes and that the Secretary be requested to forward a copy of the same and of this resolution to the family of our departed friend.

Respectfully,

THEODORE H. HITTELL,
H. H. BEHR, Dr.
Committee.

October 19, 1891.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from C. S. Capp, W. S. Bliss, W. O. Cullen, F. O. Johnson, Charles A. Keeler, Walter E. Bryant and Charles H. Townsend.

Additions to Library:

From correspondents	116
By purchase	257
By donation	27

A vote of thanks was tendered to Mr. B. Frank Leeds for his valuable donation of 26 volumes to the library.

Specimens of different mineral substances from the Yellowstone National Park were presented by G. P. Rixford.

Charles H. Gilbert read a paper on the Deep Sea Work of the U. S. F. C. S. Albatross.

November 2, 1891.—STATED MEETING.

The PRESIDENT in the chair.

The following were proposed for honorary membership: Otto Stoll, Sereno Watson, W. H. Brewer, George F. Goodale, J. A. Allen and Herman Graf zu Solms-Laubach.

Additions to Library:

From correspondents	108
By purchase	46
By donation	112

The thanks of the Academy were voted to the State Mining Bureau, Dr. Harkness, T. S. Brandegee and the Zoe Publishing Company for valuable donations to the Library.

A communication from Lieutenant John P. Finley was read, conveying the information of his relief from duty as officer in charge of the Pacific Coast Weather Service and announcing his departure from San Francisco.

Voted, that "The Secretary of the Academy be requested to communicate to Lieutenant John P. Finley that this Academy deeply regrets his departure from this field of labor to which he is so pre-eminently fitted, and desires to express its appreciation of the valuable services to science performed by him while in charge of this division. Also to convey to him the thanks of the Academy for many courtesies extended by him and to assure him of its best wishes for his future welfare."

O. P. Jenkins delivered a lecture on the ultimate structure of muscle and nerve and modern appliances used in their investigation.

The following memorial notice was presented:

HENRY EDWARDS.

At a previous meeting of this society there was announced the loss, by death, of a member who had in former years held important offices and taken an active interest in the affairs of the Academy, one who was well and favorably known to the public in general as well as in scientific circles. That member was Henry Edwards, the tragedian and entomologist.

Mr. Edwards was born in Herefordshire, England, August 17, 1830. His early life was devoted to the study of law, and later he took to the stage as a profession. In 1853 he sailed to Australia, and thence to Peru, Panama and California, and from these countries he obtained the charming sketches for his book entitled "Mingled Yarns."

Mr. Edwards possessed one of the largest private collections of butterflies in the world, and his courtesy in identifying species for others was well-known and appreciated by his correspondents.

In 1867 he was elected a member of the California Academy of Sciences, and on January 2, 1877, he became a life member.

In 1874 he held office as a trustee of this society. For three consecutive years (1875–1877) he was the First Vice-President of the Academy. In 1877 he moved to the East and engaged in his theatrical profession.

Mr. Edwards published a number of valuable entomological papers, notably his descriptions of Pacific Coast Lepidoptera" and "Bibliographical Catalogue of the Described Transformations of North American Lepidoptera."

December 7, 1891.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from L. Belding, E. H. Fiske, F. O. Johnson, S. Giannetoni, A. V. La Motte, Walter E. Bryant, H. W. Harkness, Mrs. A. Van S. Sumner and Charles Fuchs.

Additions to Library:

From correspondents	150
By purchase	24
By donation	31

Specimens of slate from El Dorado County, California, prepared to show the toughness, cleavage and flexibility, were exhibited, and a paper was read, prepared by Melville Attwood, on its chemical analysis.

David S. Jordan delivered a lecture on the Salmon and Trout of the Pacific Coast.

December 21, 1891.—STATED MEETING.

The PRESIDENT in the chair.

Additions to Library:

From correspondents	91
By purchase	11
By donation	5

The Nominating Committee reported the following ticket:

For *President*, H. W. Harkness.
First Vice-President, H. H. Behr.
Second Vice-President, J. G. Cooper.
Corresponding Secretary, Frederick Gutzkow.
Recording Secretary, J. R. Scupham.
Treasurer, L. H. Foote.
Librarian, Carlos Troyer.
Director of Museum, J. Z. Davis.
Trustees, W. C. Burnett, C. F. Crocker, D. E. Hayes, E. J. Molera, George C. Perkins, Adolph Sutro, John Taylor.

January 4, 1892.—ANNUAL MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from William F. Nolte.

Otto Stoll, Sereno Watson, W. H. Brewer, George L. Goodale, J. A. Allen and Herman Graf zu Solms-Laubach were elected honorary members.

William E. Ritter was elected a resident member.

The annual reports of the officers and Board of Trustees were read and ordered filed.

The officers of election reported the following officers elected for the ensuing year:

H. W. HARKNESS, *President*.
H. H. BEHR, *First Vice-President*.
J. G. COOPER, *Second Vice-President*.
FREDERICK GUTZKOW, *Corresponding Secretary*.
J. R. SCUPHAM, *Recording Secretary*.
L. H. FOOTE, *Treasurer*.
CARLOS TROYER, *Librarian*.
J. Z. DAVIS, *Director of Museum*.

Trustees:

W. C. BURNETT, C. F. CROCKER, D. E. HAYES,
E. J. MOLERA, GEORGE C. PERKINS, ADOLPH SUTRO,
JOHN TAYLOR.

Additions to the Museum for the Year 1891.

Unless otherwise stated, the following accessions were received by donation:

N. Ahrens, San Francisco: cranium with horn-cores and one horn of *Bos primigenius* from Alaska.

Dr. W. Allen, Boulder Creek, Cal.: specimens of fossil bones in sandstone.

Melville Attwood, San Francisco: precious opals in the matrix (basalt) from near Moscow, Wash.

George B. Badger, Santa Cruz, Cal.: 23 skins and 22 crania of Californian mammals.

F. W. Bancroft, Berkeley, Cal.: 5 specimens of mammals in alcohol.

J. A. Barr, San Francisco: 1 specimen crustacean.

Dr. H. H. Behr, San Francisco: specimen of Gryllotalpa and Gordius.

L. Belding, Stockton, Cal.: 49 birds' skins; 4 birds in the flesh; 15 birds' eggs and 2 nests; head of *Putorius brasiliensis frenatus;* head of *Olor buccinator;* pelt of *Tamias merriami;* 1 specimen *Salmo irideus;* 1 fresh water shell from Lower California.

W. A. Bissell, San Francisco: specimens of lignite.

Walter D. Bliss, Carson City, Nev.: 7 specimens of mammals in alcohol.

W. S. Bliss, Bijou, Cal.; 1 specimen of *Scapanus townsendii* in the flesh and 2 specimens of *Picicorvus columbianus* in the flesh.

M. Braverman, Visalia, Cal.: collection of identified fossils from various localities; 1 specimen *Latrodectus verrecundum.*

Walter E. Bryant, Curator: 8 specimens of birds; 15 specimens of mammals and 16 crania; living specimen of *Bufo lentiginosus;* 3 specimens *Diemyctilus torosus;* 6 specimens (1 species) Neuroptera from Oakland, Cal.; 2 fossil shells; 1 Gordius; 10 fish; 10 reptiles; 1 specimen Vespertilio; 5 batrachians; 14 specimens Curculionidæ; 1 specimen Avian osteology.

California State Fish Commission: 2 specimens Salmonidæ.

C. S. Capp, San Francisco: cast off skin of *Bascanium* sp.?

J. R. Chalker, Glendora, Cal.; lizard with abnormal tail.

Dr. E. S. Clark, San Francisco: 3 Coleoptera; 1 crustacean; 1 marine worm.

Dr. J. G. Cooper, Haywards, Cal.: Specimen of *Amblystoma californiense* alive.

W. O. Cullen, San Francisco: 1 specimen of *Pica pica hudsonica* in the flesh.

George W. Dunn, San Francisco: 1 snake.

Miss Alice Eastwood, Denver, Colo.: 5 birds' eggs and 2 nests; 10 specimens Coleoptera.

Dr. Gustav Eisen, San Francisco: 1 specimen *Atalapha cinerea;* 2 specimens of *Cottus* sp.?

H. H. Ellis, San Francisco: specimen of fossil coral.

Adolph T. W. Erzgraber, San Jose, Cal.: A miniature egg from inside of normal egg of domestic fowl.

E. H. Fiske, Santa Cruz, Cal.: 3 skins with crania of *Sciurus fossor nigripes*.

E. D. Flint, Oakland Cal.: 1 specimen of *Falco sparverius* in the flesh.

Charles Fuchs, San Francisco: representatives of 77 families of North American Coleoptera; 1 human cranium from Manilla; 1 specimen Anser in the flesh.

S. Giannetoni, San Francisco (through *Horace V. Scott*): specimen of *Hexagrammus superciliosus*.

W. J. Golcher, San Francisco: 1 specimen of *Anas discors* in the flesh.

Dr. H. W. Harkness, San Francisco: 4 specimens *Coregonus clupeiformis*.

J. T. Hill, Redding, Cal.: 3 specimens of gold ore from Electric Light Mine, Redding.

Charles Hoffman, Oakland, Cal.: living specimen of *Sciuropterus volucella hudsonius*.

Fred. O. Johnson, Berkeley, Cal.: 3 specimens of birds; 1 reptile alive; living specimen of *Bascanion constrictor vetustus*.

Charles A. Keeler, Berkeley, Cal.: 179 specimens avian osteology.

Charles A. Keeler and *Walter E. Bryant:* 10 specimens of mammals and 8 specimens of birds; 9 birds' skeletons; 6 reptiles; 1 batrachian.

Charles W. Knox, Oakland, Cal.: 1 specimen *Thomomys talpoides umbrinus* in the flesh; 1 specimen of *Phrynosoma* sp.?

Alfred V. La Motte, Glen Ellen, Cal.: 1 specimen *Melanerpes torquatus* in flesh; 1 living *Bassariscus astuta;* 1 specimen *Lophodytes cucullatus* in flesh; 1 Siamese canoe; living specimen of *Pituophis catenifer*.

Mrs. J. Lawley, Calistoga, Cal.: 1 living specimen of *Bassariscus astuta*.

W. E. Lingard, San Francisco: 13 specimens of birds from Alaska.

C. H. Lewis, Oakland, Cal.: 1 specimen of Belastoma.

B. Macdonald, San Francisco: 1 specimen *Crotalus lucifer*.

J. B. McChesney, Oakland, Cal.: Collection of insects, principally Coleoptera.

Stewart McClure, San Francisco: 1 living specimen of *Antrozous pallidus*.

R. C. McGregor, Denver, Colo.: 5 skins and 4 crania of Californian mammals.

Robert Moses, Concord, Cal.: 1 fossil shell.

H. S. Nichols, Healdsburg, Cal.: 5 specimens of birds and 1 mammal in the flesh; specimens of *Rhamnus Californicus*.

William F. Nolte, San Francisco: Japanese marble ball; 1 mounted specimen each of African gray parrot, Japanese blue-jay and road-runner.

Mrs. Dan. Patten, Calistoga, Cal.: 1 specimen of *Bassariscus astuta* in the flesh; 1 specimen fossil leaf impression.

G. P. Rixford, San Francisco: 3 specimens of marble with Indian pictographs, from Inyo county; 215 specimens shells; 24 specimens of tufas, representing formations in Yellowstone Park; 1 specimen obsidian.

Wm. A. Robbins, San Francisco: 1 egg of *Cathartes aura.*

William Ryan, Field's Landing, Cal.: 4 specimens of *Branta nigricans* in flesh, and a bunch of eel-grass (*Zostera marina*).

W. H. Shockley, Candelaria, Nev.: 1 *Salmo mykiss*; 1 *Salmo irideus*; 2 *Squalius (conformis?).*

Hon. Leland Stanford, Menlo Park, Cal.: 1 specimen *Bascanion constrictor*, alive.

D. C. Stone, San Francisco: 5 living specimens of albino rat.

Mrs. Adeline Van S. Sumner, San Francisco: living specimen of *Chondrotus tenebrosus.*

Charles H. Townsend, U. S. F. C. S. Albatross: 1 specimen of *Strix pratincola* in the flesh; 1 skin of *Simorhynchus pusillus*, and 1 birds' nest.

Carlos Troyer, San Francisco: 1 specimen of Neuroptera.

Frank H. Vaslit, San Francisco: 1 specimen of *Vespertilio* sp.? and 1 *Prionus californicus* in alcohol; 1 specimen of *Scapanus townsendii*, in the flesh.

Mrs. S. E. Vaslit, San Francisco: 1 specimen of *Scapanus townsendii*, in the flesh.

W. M. Willey, San Francisco: 1 abnormal egg of domestic fowl.

Mrs. H. B. Wilson, Healdsburg, Cal.: 1 arachnid.

Ramon E. Wilson, San Francisco: 2 specimens Variscite, from 1,800-foot level, Holmes mine, Candelaria, Nev.

B. C. Winston, Monterey, Cal.: 2 specimens quadramana, in the flesh; 1 *Cebus capucinus*, in the flesh.

R. A. A. Wright, San Francisco: anatomical specimen from young walrus (*Odobœnus obesus*) taken in Arctic ocean.

Mrs. R. A. A. Wright, San Francisco: crystal from cave at Havana.

Unknown donor: 1 specimen *Dytiscus marginicollis.*

Purchased; 1 specimen *Botaurus lentiginosus*, in the flesh; 2 skins of *Lophodytes cucullatus;* 33 stone implements; 1 bottle pigment; 1 reptile in alcohol.

February 1, 1892.—Stated Meeting.

The President in the chair.

Additions to Library:

From correspondents	133
By purchase	14
By donation	6

Charles A. Keeler read a paper on Heredity in its Relation to the Inheritance of Acquired Characters.

February 15, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the museum were reported from Charles A. Keeler, H. Abbott, Herbert Brown, E. D. Flint, Miss Louise A. Littleton, George B. Badger,, Charles N. Comstock, T. B. Sanders, George W. Dunn, William G. Blunt and Walter E. Bryant.

Additions to Library:

From correspondents	80
By purchase	75
By donation	5

Dr. Gustav Eisen read a paper entitled "The Evolution of the Forms of Trees as produced by Climatic Influences."

March 7, 1892.—STATED MEETING.

The PRESIDENT in the chair.

W. L. Watts and Alice Eastwood were proposed for membership.

Donations to the museum were reported from W. S. Bliss, Gustav Eisen and T. B. Sanders.

Letters were read announcing the donation to the herbarium of a collection of Greenland plants by John H. Redfield, and of a package of specimens of Sphagna of the northeastern United States, by Edwin Faxon, and a vote of thanks was tendered to each of those gentlemen.

Charles A. Keeler read a paper entitled, "Is Natural Selection Creative?"

Dr. Harkness exhibited specimens of a species of Cynips together with the galls from which they emerge and made some remarks on their life history.

April 4, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Additions to Library:

From correspondence	140
By purchase	41
By donation	41

The President announced the death of Sereno Watson, honorary member, and of William A. Aldrich, resident member.

Dr. Harkness made some remarks concerning his observations on the life history of the Cynips infesting the oaks, and discussed the probability of the one attacking the buds being an alternate generation of the one forming the woody galls.

Frederick Gutzkow described a new process used in refining silver bullion.

Charles A. Keeler made a few remarks bearing on the question: "What constitutes a species?"

April 18, 1892.—Stated Meeting.

The President in the chair.

Alice Eastwood and William L. Watts were elected resident members.

The following communication was read:

San Francisco, April 18, 1892.

Secretary California Academy of Sciences:

Dear Sir—The proprietors of Zoe have the honor to offer for acceptance of the Academy fifty copies each of volumes i and ii of that journal to be distributed to the principal societies of the world which are in correspondence with the Academy, in grateful acknowledgment of favors granted to the California Zoological Club and the California Botanical Club.

Respectfully,

H. W. HARKNESS,
T. S. BRANDEGEE,
KATHARINE BRANDEGEE.

The President then introduced Mr. Edward Muybridge, who delivered a lecture on The Science of Animal Locomotion, with lantern illustration of consecutive phases of animal movements and synthetical reproductions by the zoopraxiscope.

May 2, 1892.—Stated Meeting.

The President in the chair.

Additions to Library:

From correspondents	77
By purchase	107
By donation	1

Dr. H. H. Behr read a paper on the Flight of Insects,

Dr. Harkness exhibited gall wasps just hatched from leaf-bud galls of the oak.

The President announced the purchase of the skeleton of a whale, which will be mounted and placed in the gallery of the Museum.

June 6, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from Mrs. M. Burton Williamson, Miss McVenn, W. J. Raymond, T. S. Brandegee, Dr. C. L. Anderson, Dr. Dozier, F. Engles, Henry Hemphill, Gustav Eisen, R. Reid and Dr. S. Bowers.

Additions to Library:

From correspondents	155
By purchase	124
By donation	11

The President announced the death of J. J. Rey, L. L. Robinson and S. M. Wilson, life members, and of Prof. E. Regel, honorary member.

Dr. Gustav Eisen made a preliminary report on the expedition to Lower California.

June 20, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Dr. Gustav Eisen read a paper on the Lost Civilization of the Mayas, as Indicated by Archæological Remains in Mexico and Central America, illustrated by stereopticon views.

July 18, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Anthony W. Vogdes was proposed for membership.

Additions to Library:

From correspondents	369
By purchase	48
By donation	23

S. W. Holladay read a paper on Earthquake Freaks.

Charles A. Keeler gave an account of his recent trip to the Farallon Islands, and exhibited a portion of the collections made on the trip.

August 1, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from S. Reubel, W. W. Price, A. W. Anthony, Dr. J. G. Cooper, John Carlson, Frank H. Vaslit, W. O. L. Crandall, Agent S. P. Co., Indio, Cal., C. W. Knox, Frank H. Holmes, Charles Fuchs, Mr. Goebig, M. Braverman, E. D. Flint, J. W. Barry, Dr. Harkness, Charles A. Keeler and J. J. Kinrade.

Additions to Library:

From correspondents 56
By purchase 118
By donation 13

A paper, by William W. Price, on the Discovery of a New Grove of *Sequoia gigantea*, was read by Walter E. Bryant.

A paper, by Dr. J. G. Cooper, on Land and Fresh-water Shells of Lower California, was read by title.

The Secretary read a paper, prepared by Melville Attwood, on the advisability of making an exhibition of Californian iron ores at the World's Columbian Exposition.

Dr. Harkness exhibited a living specimen of Amblystoma and made some remarks concerning its metamorphosis.

Charles A. Keeler and Prof. W. E. Ritter discussed certain points in Romanes' theory of natural selection.

September 5, 1892.—Stated Meeting.

The President in the chair.

Oscar T. Baron was proposed for membership.

Donations to the museum were reported from W. G. Blunt, Carlos Troyer, R. G. Stitt, Lieutenant Holcomb, E. W. Jones, Melville Attwood, R. C. McGregor, Miss Effie A. McIllriach, George B. Badger, Sidney M. Smith, Mrs. Nuttall, Mrs. Bush, A. W. Crawford and T. H. Hittell.

Additions to Library:

From correspondents 174
By purchase 1044
By donation 8

E. W. Jones, by invitation, addressed the Academy on the subject of tin mining, explaining the methods used at the Temescal mine in working the ore.

Charles Fuchs made some remarks on *Phlœosinus dentatus* Say, which is ravaging the cypress trees.

September 19, 1892.—Stated Meeting.

The President in the chair.

J. C. Branner was proposed for membership.

Donations to the museum were reported from C. H. and Dr. E. S. Clark, Henry Lorenzen, J. B. Haggin, James E. Requa, Carlos Troyer, G. P. Rixford and Mrs. A. E. Bush.

Additions to Library:

From correspondents	70
By purchase	128
By donation	9

Charles A. Keeler read a paper entitled "Sexual Selection as a Factor in the Beautiful in Nature."

October 3, 1892.—Stated Meeting.

The President in the chair.

Anthony W. Vogdes and Oscar T. Barron were elected resident members.

Donations to the museum were reported from H. S. Nichols, Miss Effie A. McIllriach, Olaf Olsen, Dr. J. G. Cooper, Dr. L. D. Morse and M. Braverman.

Additions to Library:

From correspondents	61
By purchase	13
By donation	2

Major J. W. Powell, Director of the U. S. Geological Survey, delivered a lecture on the Aboriginal Tribes of North America.

The thanks of the Academy were voted to Major Powell.

October 17, 1892.—Stated Meeting.

The President in the chair.

Donations to the Museum were reported from F. A. Marriott, Jr., Mrs. C. A. Boland, Frank Miller, Dr. J. G. Cooper, Captain Hultman, George E. Twitchell and Thomas C. Johnston.

A vote of thanks was tendered to Mr. Thomas C. Johnston for his donation of a valuable ethnological collection from the South Sea Islands.

The Secretary read an announcement of the discovery by H. W. Fairbanks of *Proetus ellipticus* Meek, a trilobite from the Waverly Group, in Shasta County, California; identified by Captain A. W. Vogdes.

Lieutenant John P. Finley delivered a lecture on Phases of Pacific Coast Weather and Violent Local Storms, illustrated with stereopticon views.

A vote of thanks was tendered Lieutenant Finley.

November 7, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from John Carlsen, Gustav Eisen, Carl Precht, Dr. J. G. Cooper, John L. Howard.

Additions to Library:

From correspondents	82
By purchase	77
By donation	6

November 21, 1892.—STATED MEETING.

T. H. HITTELL in the chair.

James P. Smith was proposed for membership.

Donations to the Musuem were reported from Willard M. Wood, Miss Lottie Rau, George H. Knight, Sam Hubbard, Jr., Overend G. Rose, M. H. Gilson, T. S. Brandegee.

Additions to Library:

From correspondents	81
By purchase	21
By donation	2

H. W. L. Couperus read a paper on the Possibility of the Cultivation of Coffee within the Limits of the Unlted States.

A committee, consisting of Dr. Harkness, T. S. Brandegee and J. R. Scupham, having been appointed by the Council to represent the Academy in a general committee from the universities and scientific societies to organize and promote the means of procuring a topographical map of the valley areas of California, made their report to the Academy through Mr. Scupham, who offered the following resolution:

WHEREAS, The General Government, through the Director of the Geological Survey, consents to co-operate with the State of California in the survey and mapping of the valley areas of California, to the extent of superintending the work and defraying one-half of the expense;

Resolved, That the Academy heartily endorses the proposition to secure an appropriation from the State Legislature that will cover the annual expense of $25,000 for securing such survey and map.

Action on the resolution was deferred until the next meeting.

December 5, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from Walter H. Levy, Gustav Eisen, William Hooper, W. G. Blunt, John P. West and Compania Minera y Beneficiadora de la Barranca, Sonora, Mexico.

Additions to Library:

From correspondents	67
By purchase	15
By donation	2

The resolution introduced at the last meeting giving the Academy's endorsement to the effort on foot to secure for the State a topographical map, was discussed and finally carried, after having been amended to read as follows:

Resolved, That the Academy heartily indorses the proposition to secure an appropriation from the State Legislature that will cover the annual expense of $25,000 for securing such survey and map, that the scale be not less than one inch to the mile, and that the whole area of the State be included in the survey.

December 19, 1892.—STATED MEETING.

The PRESIDENT in the chair.

Donations to the Museum were reported from Herbert Kellogg, Walter H. Levy, W. E. Steadman, Baron Boeselager, Walter E. Bryant and G. E. Colwell.

Additions to Library:

From correspondents	64
By purchase	16
By donation	3

The Nominating Committee made their report naming the following ticket.

For *President*, H. W. Harkness.
First Vice-President, H. H. Behr.
Second Vice-President, J. G. Cooper.
Corresponding Secretary, T. S. Brandegee.
Recording Secretary, J. R. Scupham.
Treasurer, L. H. Foote.
Librarian, Carlos Troyer.
Director of Museum, J. Z. Davis.
Trustees, W. C. Burnett, C. F. Crocker, D. E. Hayes, E. J. Molera, George C. Perkins, Adolph Sutro, John Taylor.

January 3, 1893.—Annual Meeting.

The President in the chair.

Donations to the museum were reported from Ed. Garner, P. F. Roundtree, Dr. Julius Rosenstirn, Wm. F. Nolte and Charles Alison.

Additions to the Library for the year 1892, were reported as follows:

From correspondents	1720
By purchase	1876
By donation	136

The annual reports of the officers were read and ordered filed.

The judges and inspectors of election reported the following officers elected for the ensuing term:

H. W. Harkness, *President.*
H. H. Behr, *First Vice-President,*
J. G. Cooper, *Second Vice-President.*
T. S. Brandegee, *Corresponding Secretary.*
J. R. Scupham, *Recording Secretary.*
L. H. Foote, *Treasurer.*
Carlos Troyer, *Librarian.*
J. Z. Davis, *Director of Museum.*

Trustees.

W. C. Burnett, Charles F. Crocker, D. E. Hayes,
E. J. Molera, George C. Perkins, Adolph Sutro,
John Taylor.

Additions to the Museum for the Year 1892.

Unless otherwise specified these accessions are by donation.

H. Abbott, San Francisco: abnormal specimen of young sheep.

Agent Southern Pacific Co., Indio, Cal.: 1 moth and 1 scorpion, in alcohol.

Charles Alison, San Francisco: Collection of centipedes and Thysanuras in alcohol.

Dr. C. L. Anderson, Santa Cruz, Cal.: 15 species shells.

A. W. Anthony, San Diego, Cal.: 1 pelt of deer (*Cariacus macrotis*).

Melville Attwood, San Francisco: specimen of lignite.

George B. Badger, Santa Cruz, Cal.: 6 specimens serpents; 1 batrachian, and 2 Chiroptera in alcohol; collection of reptiles in alcohol.

J. W. Barry, San Francisco: 1 fish.

W. S. Bliss, Carson City, Nev.: 1 specimen of *Peropsperotis californicus,* in the flesh.

William G. Blunt, San Francisco: 2 specimens of *Callipepla squamata* and 1 Sitomys in the flesh; 2 *Himantopus mexicanus* in the flesh; 1 *Callipepla gambeli* in the flesh.

Baron Boeselager, Mount Angel, Or. (through *Dr. H. H. Behr*): Indian stone relic.

Mrs. C. A. Boland, Utica, N. Y.: specimen of *Columba fasciata* in the flesh.

Dr. S. Bowers, Ventura, Cal.: 82 specimens of Tertiary fossils from Southern California.

T. S. Brandegee, San Francisco: a set of the lichens of Colorado and a set of lichens of the Yakima region of Washington, all named by Dr. Tuckerman and Charles James Sprague; 1 species shells.

M. Braverman, Visalia, Cal.: 1 *Latrodectus verrecundum* and 1 *Scorpio alleni* in alcohol; 5 specimens of reptiles in alcohol, and ten bottles of miscellaneous alcoholic specimens.

Herbert Brown, Tucson, Ariz.: specimen of *Crotaphytus collaris* in alcohol.

Walter E. Bryant, Curator: 1 cranium of *Neotoma fuscipes*: 1 *Zonotrichia coronata*; 1 *Callipepla californica*; 1 *Anas carolinensis*; skins.

Mrs. A. E. Bush, San Jose, Cal.: 63 species of fossil shells from San Pedro and Santa Clara County; 10 species living shells; garnet sand from Monterey Beach; obsidian from Modoc County.

John Carlsen, San Francisco: 1 *Diemyctilus torosus*: specimens of lignite; 1 specimen of *Osmylus* sp.?

Carl H. and *Dr. E. S. Clark*, San Francisco: Collection of fossils from bituminous beds of Los Angeles County.

G. E. Colwell, San Francisco: Mounted specimen of *Pseudogryphus californianus*.

Compania Minera y Beneficiadora de la Barranca, Sonora, Mexico: 5 boxes of ores, principally silver.

Charles N. Comstock and *Charles Hubbard*, Oakland, Cal.: Collection of North American birds' eggs.

Dr. J. G. Cooper, Haywards, Cal.: 9 mammals; 41 birds' skins; 2 birds' nests.

W. O. L. Crandall, Olema, Cal.: 1 *Siphostoma californiense*.

A. W. Crawford, San Francisco: 2 specimens of a Helix from Australia.

Dr. Dozier, Napa, Cal.: 2 species shells.

George W. Dunn, San Francisco: 27 specimens of reptiles in alcohol.

Dr. Gustav Eisen, San Francisco: 22 specimens of land shells from Vevay, Indiana; 2 specimens reptiles; 4 specimens crustacea.

F. Engels, Santa Barbara, Cal.: 1 species shells.

E. D. Flint, Oakland, Cal.: Living specimen of *Pituophis catenifer;* 1 *Gerrhonotus multicarinatus*.

Charles Fuchs, San Francisco: 2 Thelyphonus; 2 Phrynosoma; 2 lizards; 2 snakes; 5 centipedes; 1 scorpion; 1 wasp.

Edward Garner, Quincy, Cal.: 1 *Cyanocitta stelleri frontalis:* 1 *Melanerpes torquatus:* 1 *Cinclus mexicanus:* skins.

M. H. Gilson, San Francisco: 1 labret from Alaska.

Mr. Goebig, San Francisco: 3 spiders and 103 specimens of insects, principally coleoptera, from Costa Rica.

J. B. Haggin, San Francisco: 2 mounted specimens of *Nyctea nyctea*.

Dr. H. W. Harkness, San Francisco: 2 specimens batrachians and 1 reptile.

Henry Hemphill, San Diego, Cal.: 1 species shells.

T. H. Hittell, San Francisco: specimens of *Monohamus oregonensis*.

Lieutenant Holcomb, San Francisco: 71 specimens of soundings.

Frank H. Holmes, San Jose, Cal.: 1 specimen of *Cypseloides niger*.

William Hooper, San Francisco: 2 specimens of clay stones.

John L. Howard, San Francisco: Collection of ethnological specimens from Gilbert Islands.

Sam Hubbard, Jr., Oakland, Cal.: 3 specimens of *Ægialitis montana* in flesh.

Captain Hultman, San Francisco: 1 scorpion in alcohol.

Thomas C. Johnston, San Francisco: collection of ethnological specimens from South Sea Islands.

E. W. Jones, tin ores, cassiterite, concentrated tin oxide, pure tin, slag and crystallized tin from Temescal Tin Mine.

Charles A. Keeler, Berkeley, Cal.: 1 *Atalapha cinerea* in flesh; 36 specimens of birds in alcohol; 5 birds' skeletons; collection of 30 species marine shells; collection of insects.

Herbert Kellogg, Oakland, Cal.: 1 stuffed lizard from Arizona.

J. J. Kinrade, San Francisco; 3 species of Cretaceous fossils from Glendive, Montana.

George H. Knight, San Francisco: stalacite from Calaveras County.

Charles W. Knox, Oakland, Cal.: 3 specimens of white-footed mouse (*Sitomys* sp.?); 1 *Reduvius*.

Walter H. Levy, San Francisco: 7 birds' nests and 17 eggs; 1 centipede.

Miss Louise A. Littleton, Zebra, Cal.: specimen of *Lynx baileyi*.

Henry Lorenzen, San Francisco: seed pod of *Martynia proboscidia* from Gilbert Islands.

Lower California Expedition of 1892, collected by *Walter E. Bryant*: 144 mammals; 118 mammal crania; 108 birds' skins; 4 birds' skeletons; 4 chelonians; large collection of reptiles; 3 fishes; 19 crustaceans; 17 land shells; 3185 marine shells; 18 gorgons; 12 sponges; 140 radiates; 1 specimen fungus; 24 minerals.

F. A. Marriott, Jr., San Francisco: 1 living specimen of Tarantula.

R. C McGregor, Denver, Colo.: 3 specimens *Diemyctilus torosus*.

Miss Effie A. McIllriach, San Francisco: living specimen of *Eutainia* sp.?; 1 myriapod.

Miss McVenn, Haywards, Cal.; 2 species shells.

Frank Miller, San Francisco: 1 crustacean.

Dr. L. D. Morse, San Mateo, Cal.: human frontal bone from banks of San Mateo Creek.

H. S. Nichols, Healdsburg, Cal.: 1 specimen of Arachnidæ.

William F. Nolte, San Francisco: mounted specimens of *Pelicanus erythrorhynchos* and *P. californicus.*

Mrs. Nuttall, San Francisco: fossils from the mountain Kinnekülle, Sweden.

Olaf Olsen, San Francisco: fossil tooth of mastodon.

Carl Precht, San Francisco: 1 specimen *Porzana noveboracensis* in the flesh.

W. W. Price, Oakland, Cal.: 2 skins of *Coccothraustes vespertinus montanus.*

Miss Lottie Rau, Ukiah, Cal.: specimen of *Chelopus marmoratus.*

W. J. Raymond, Oakland, Cal.: 1 species shells.

R. Reid, Haywards, Cal.: a specimen of the eastern oyster grown spontaneously at San Lorenzo, Cal., 9½ inches long and 3½ inches wide, being about seven years old and the largest yet known to have been found in San Francisco Bay.

James E. Requa, Sonora, Cal.: 3 anatomical specimens from mammals.

S. Reubel, Oakland, Cal.: 1 specimen of "Elephant Fish."

G. P. Rixford, San Francisco: specimens of *Phragmites communis* from Owen's Lake, covered with honey-dew from Aphis.

Overend G. Rose, Lakeport, Cal.: 2 skins of *Phalacrocorax dilophus.*

Dr. Julius Rosenstirn, San Francisco: 103 fishes; 92 crustaceans; 52 shells; 2 reptiles; 106 miscellaneous specimens.

P. F. Roundtree, San Francisco: 1 metate.

T. B. Sanders, Susanville, Cal.: 6 specimens of *Ampelis garrulus* in the flesh.

Sidney M. Smith, San Francisco: specimen of petrifaction from Cook's Inlet, Alaska, collected by Mr. H. M. Wetherbee.

W. E. Steadman, San Francisco: specimen of ore containing copper, silver and gold.

R. G. Stitt, Fresno, Cal.: 6 specimens of Sciuridæ.

Carlos Troyer, San Francisco: specimen of cricket; 4 reptiles; 26 batrachians; 61 fishes.

George E. Twitchell, San Francisco: 1 specimen *Tringa maculata* in the flesh.

Unknown donors: 1 fish; specimen of mineral wool; lava showing leaf impression from near Tivoli, Italy.

Frank H. Vaslit, San Francisco: 1 *Gerrhonotus multicarinatus;* 1 *Wenona plumbea.*

John P. West, San Francisco: "Bonnet" of right whale.

Mrs. M. Burton Williamson, University, Cal.: 8 species shells.

Willard M. Wood, San Francisco: 2 specimens of *Limax maximus* L. found in gardens of San Francisco.

Purchased: 2 Abalone shells from Point Arena, one containing a strange excrescence; 2 mounted specimens of *Tatusia novem-cinctus.*

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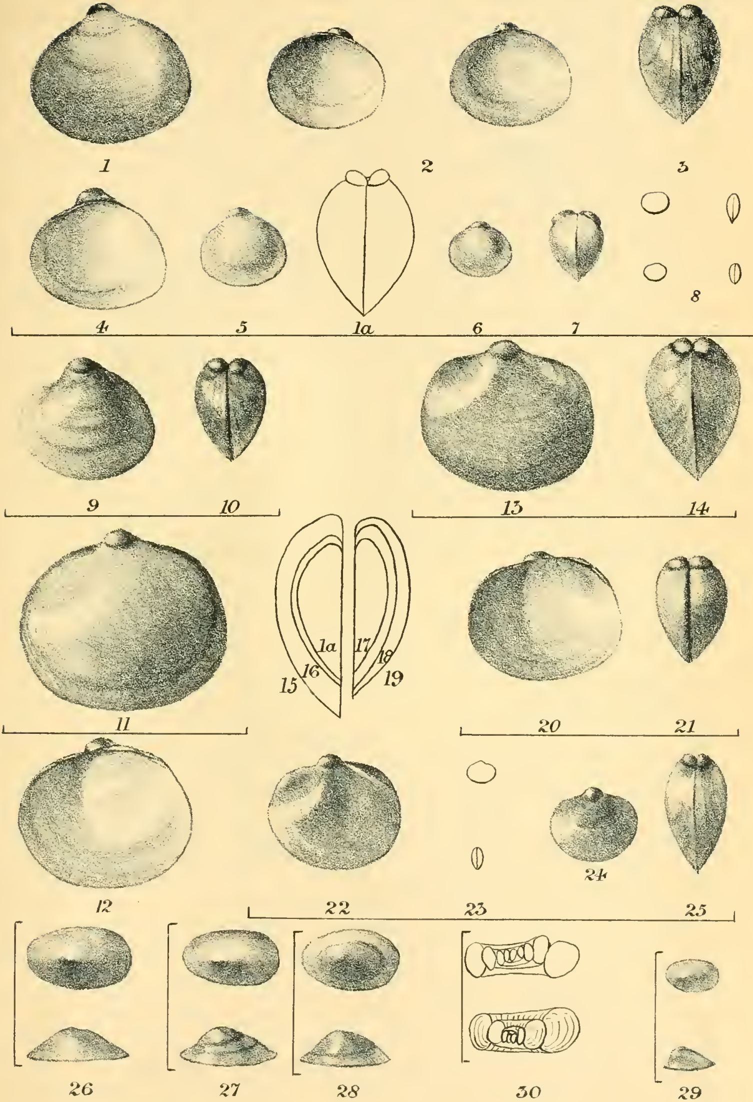
PLATE I.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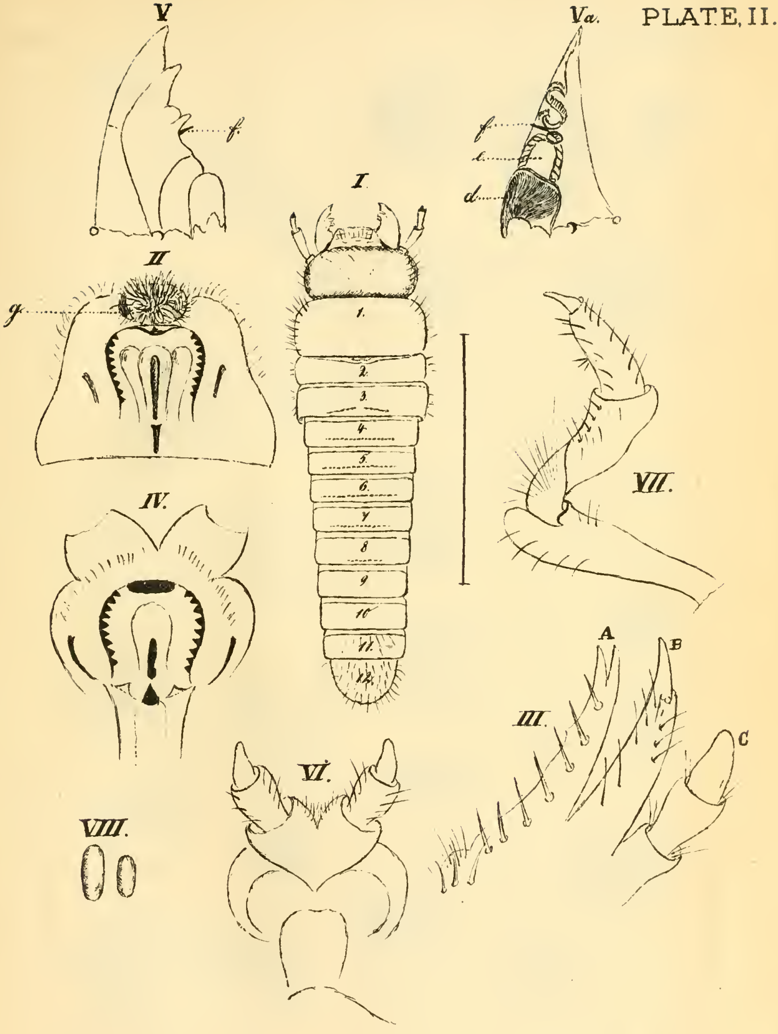

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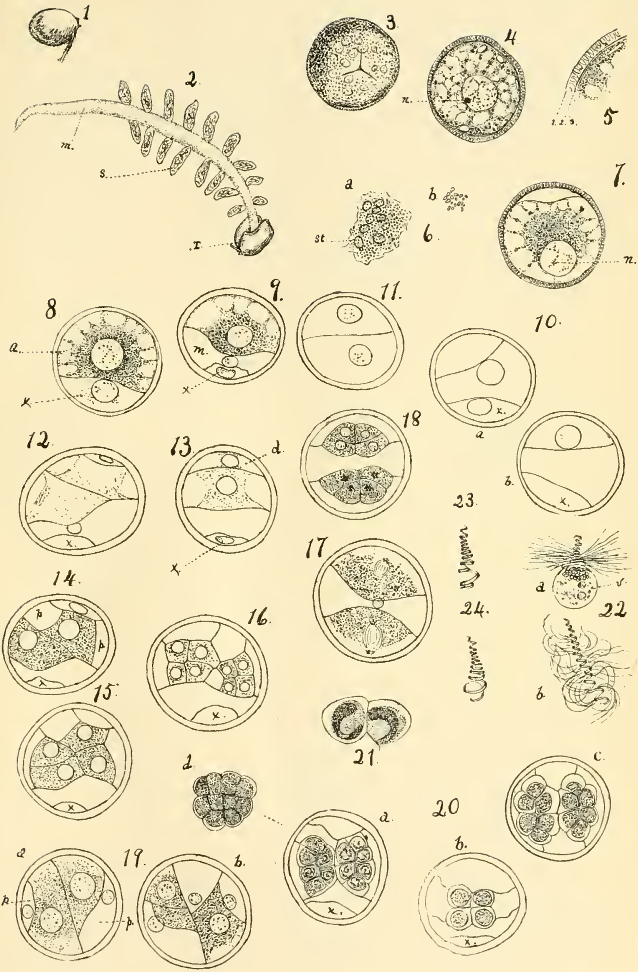

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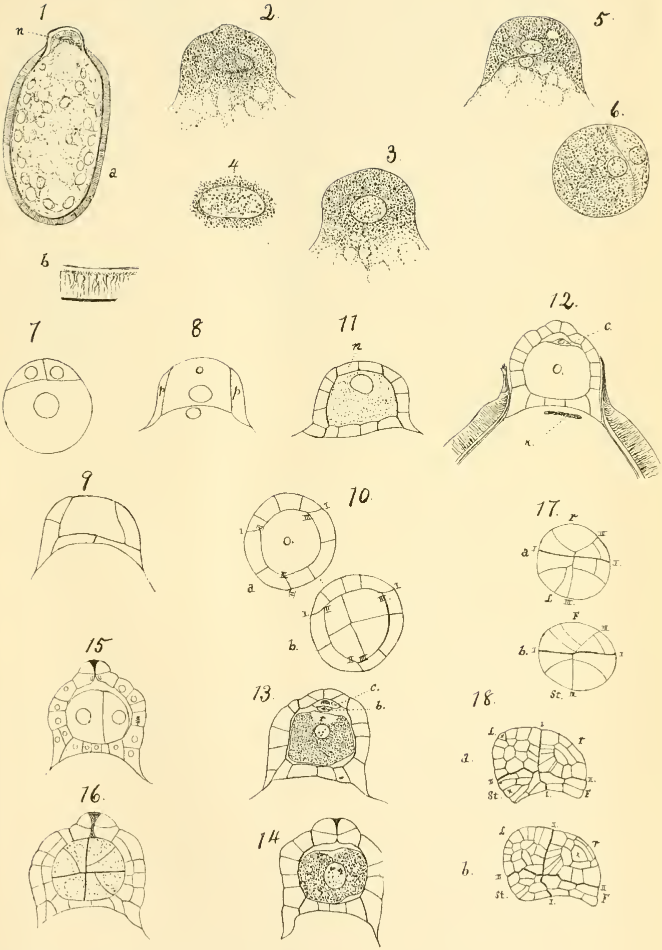

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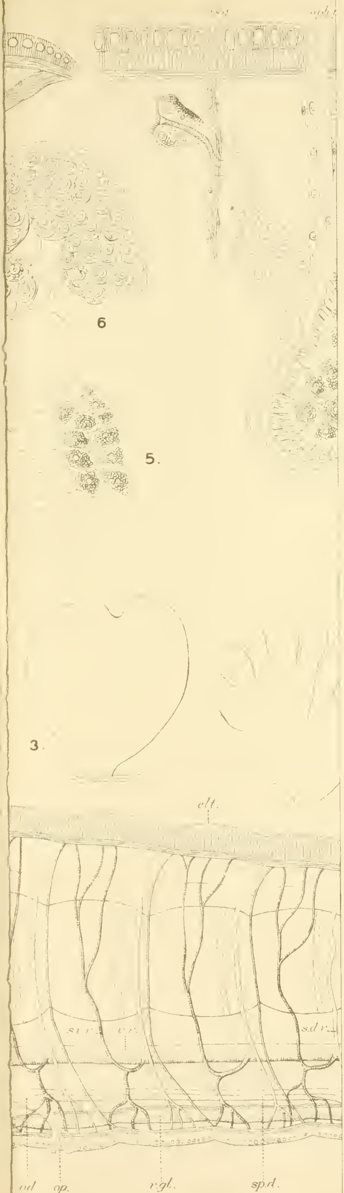
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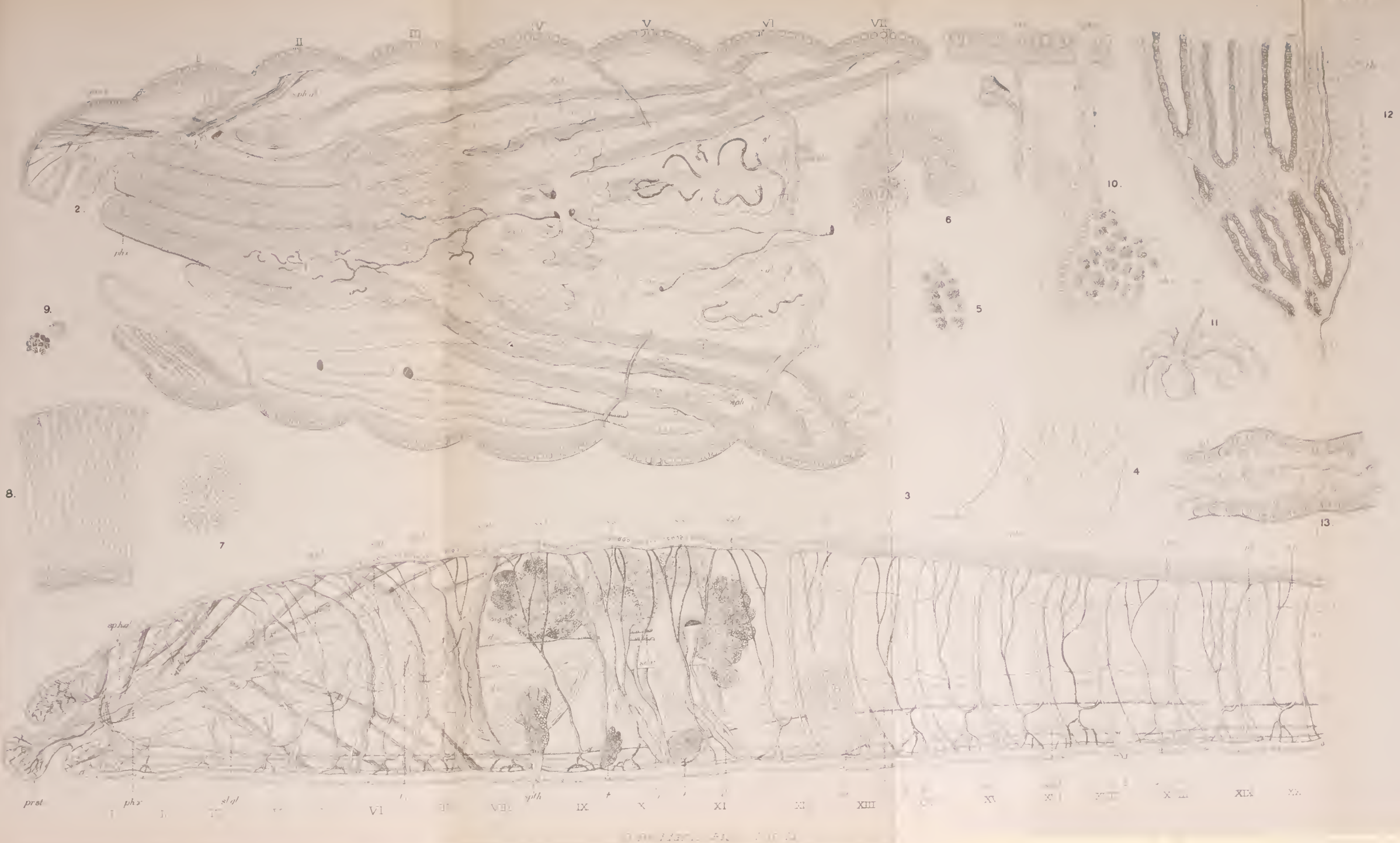

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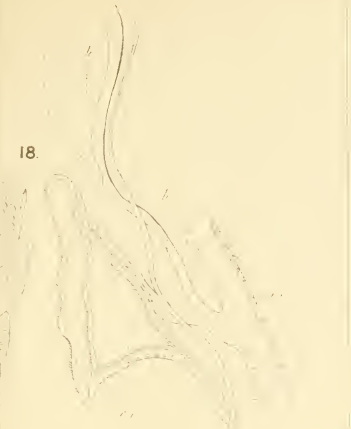

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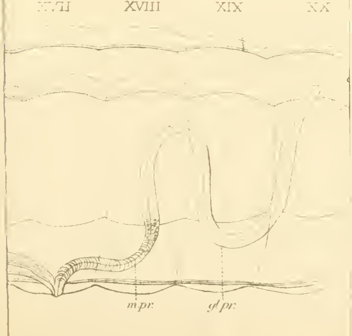

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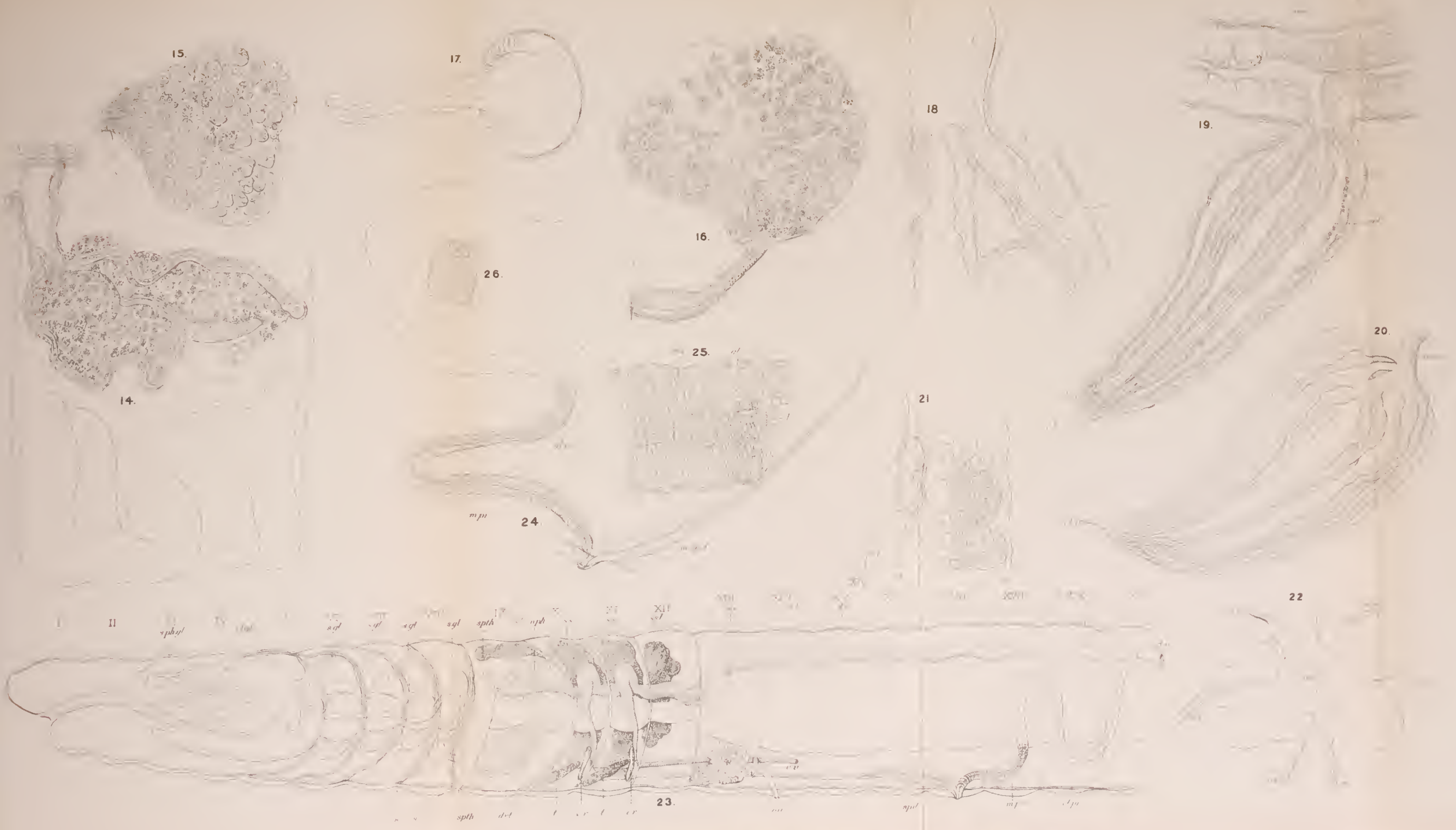
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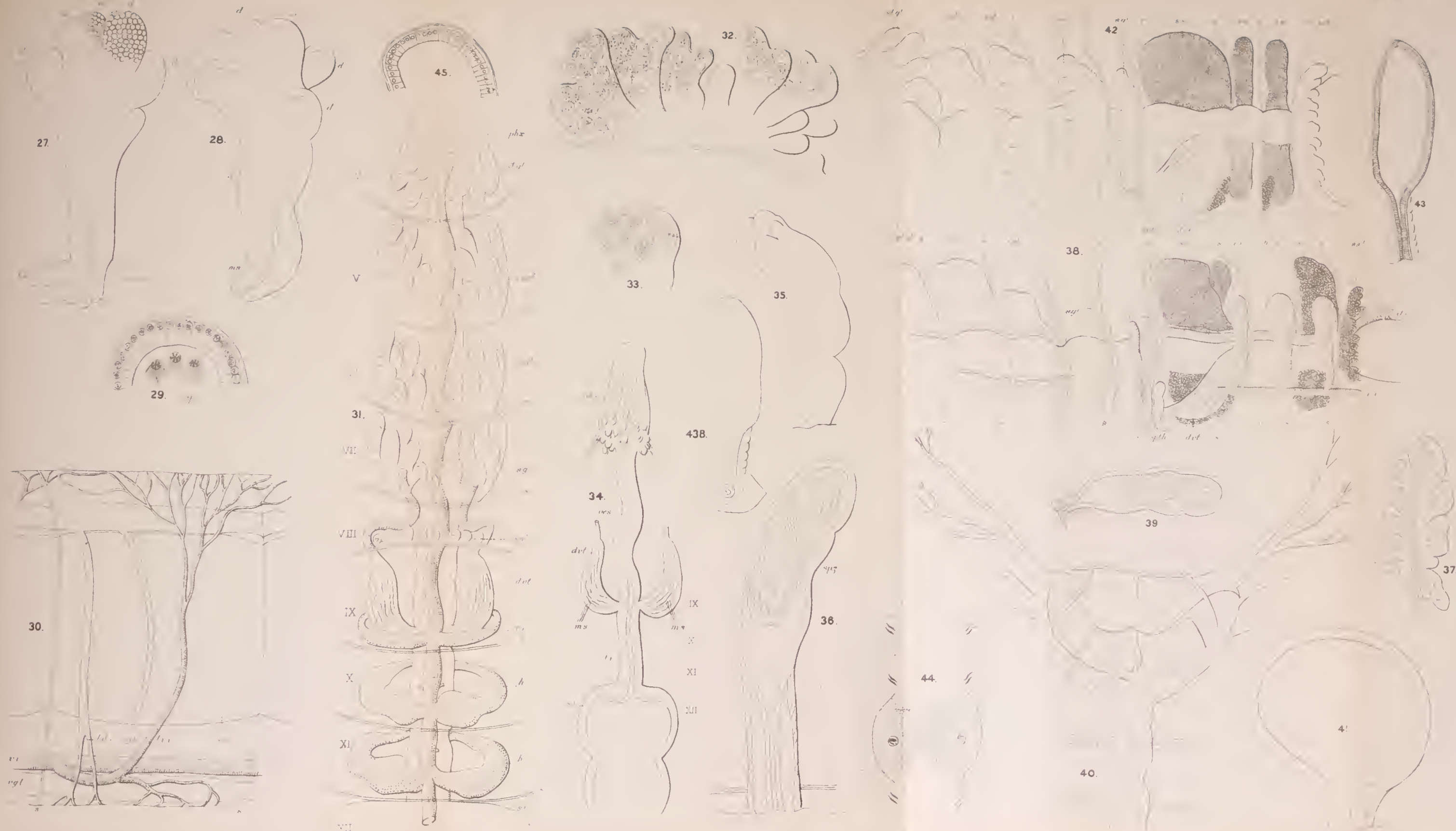
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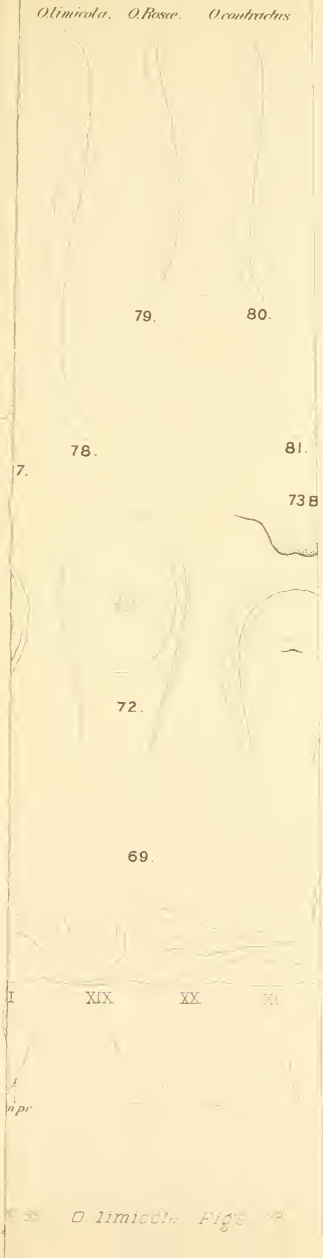
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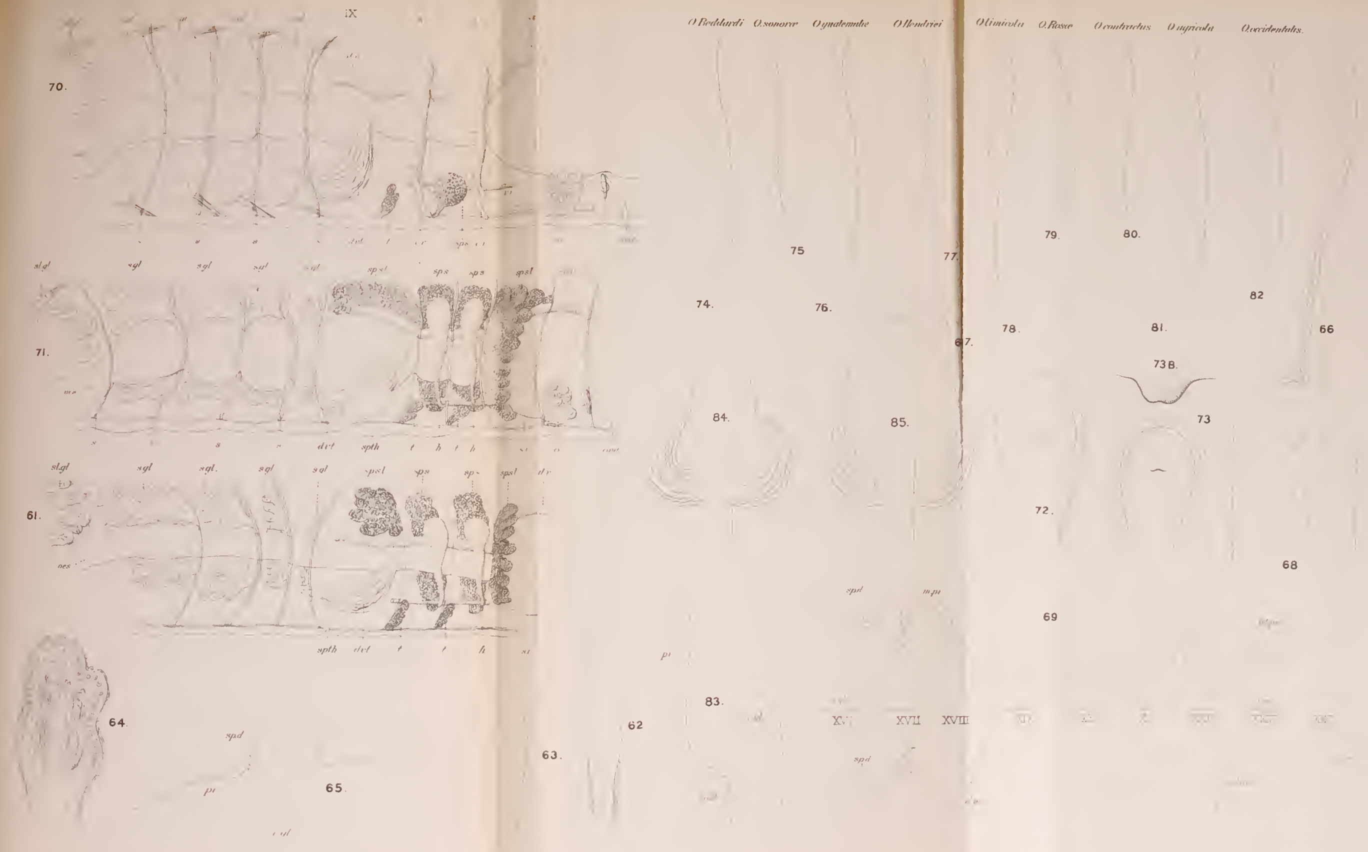
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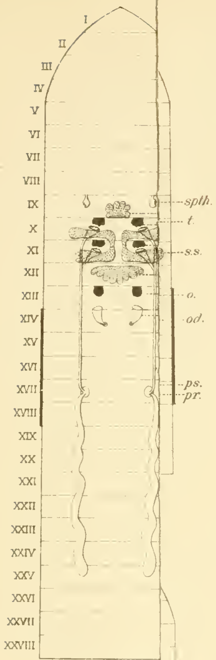

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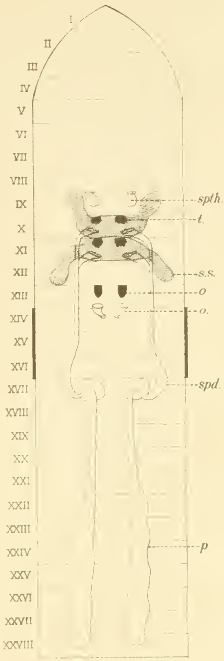

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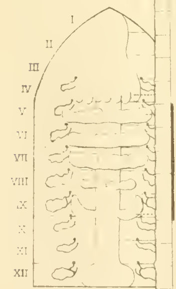

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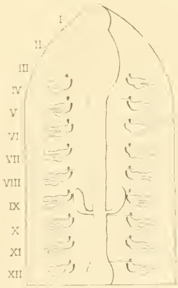

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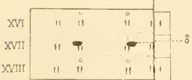

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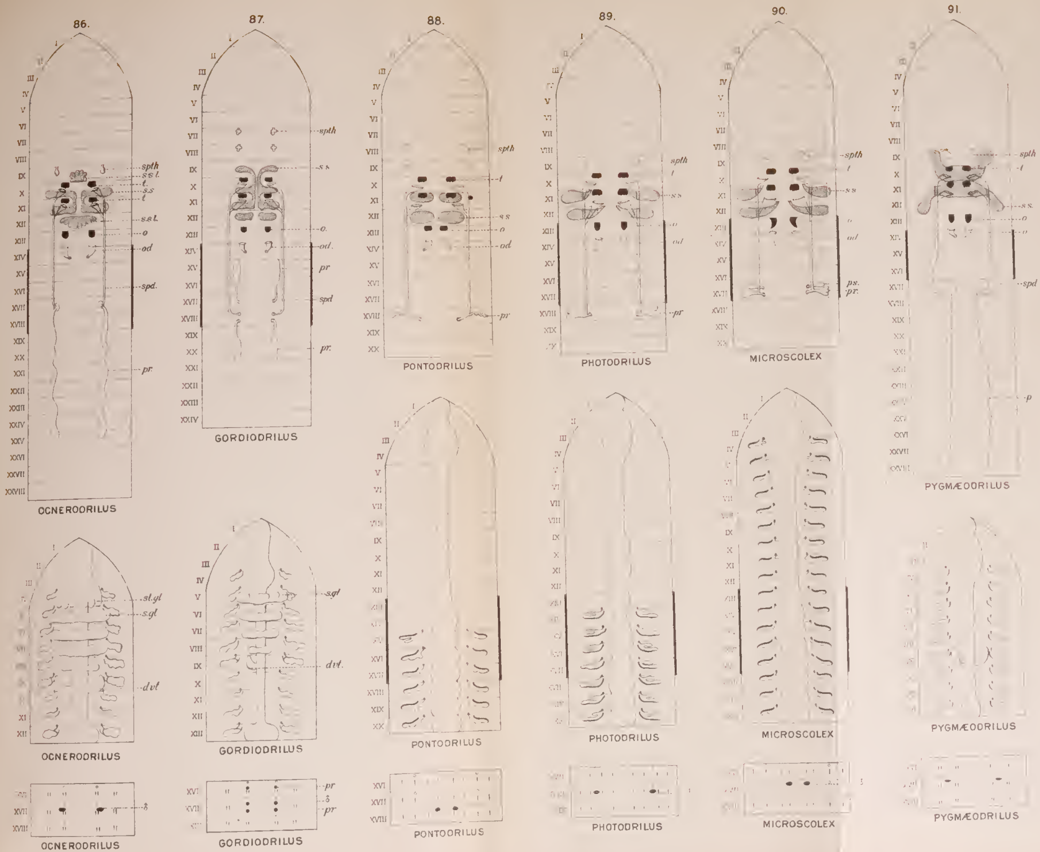
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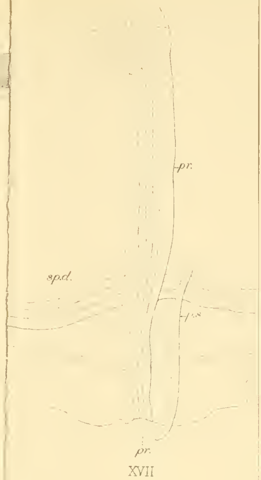

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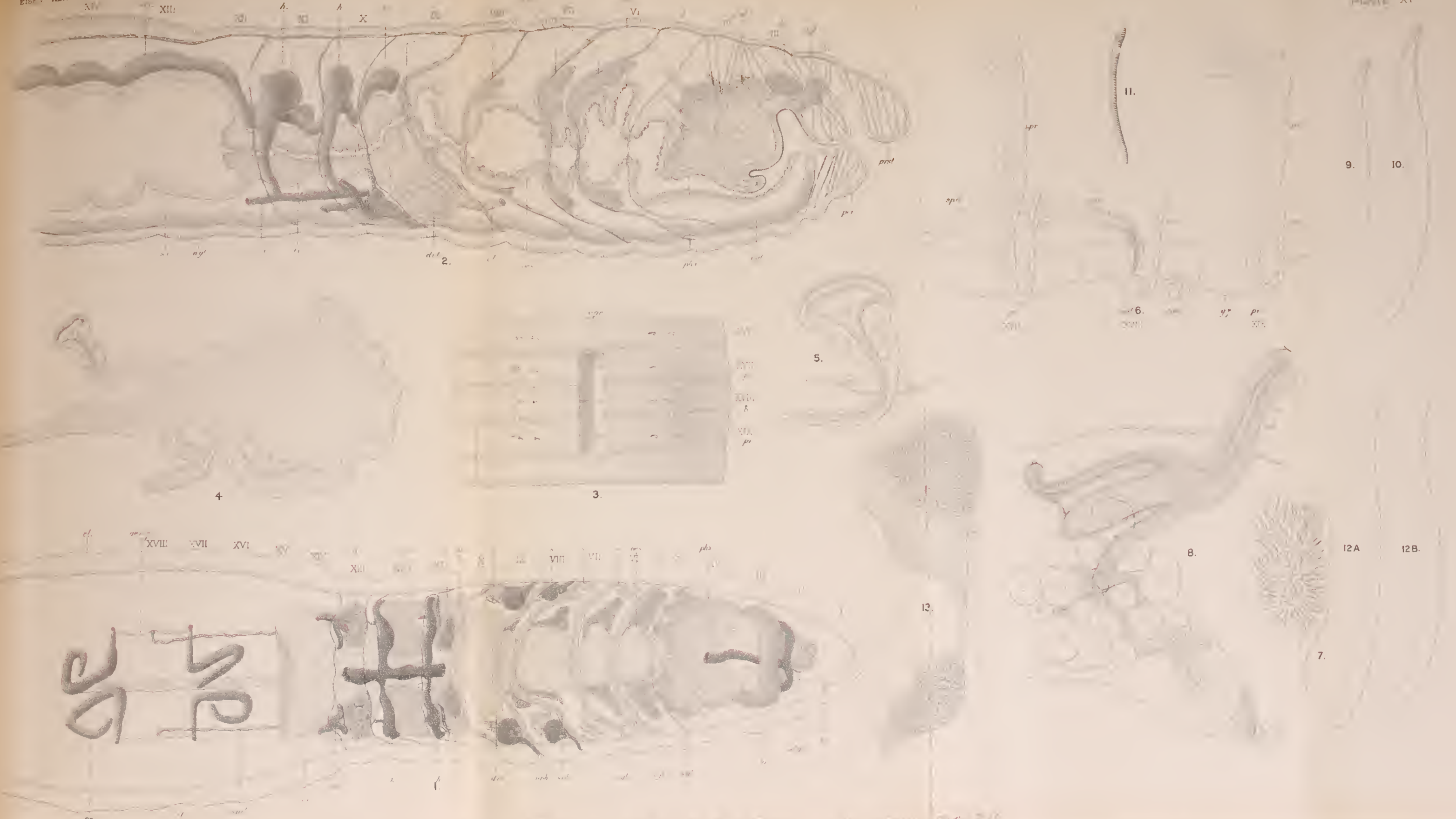

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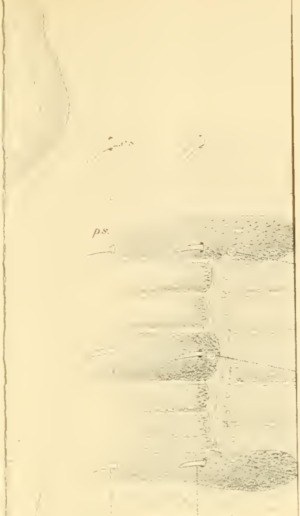

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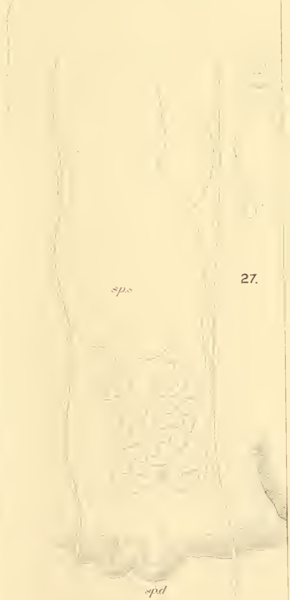

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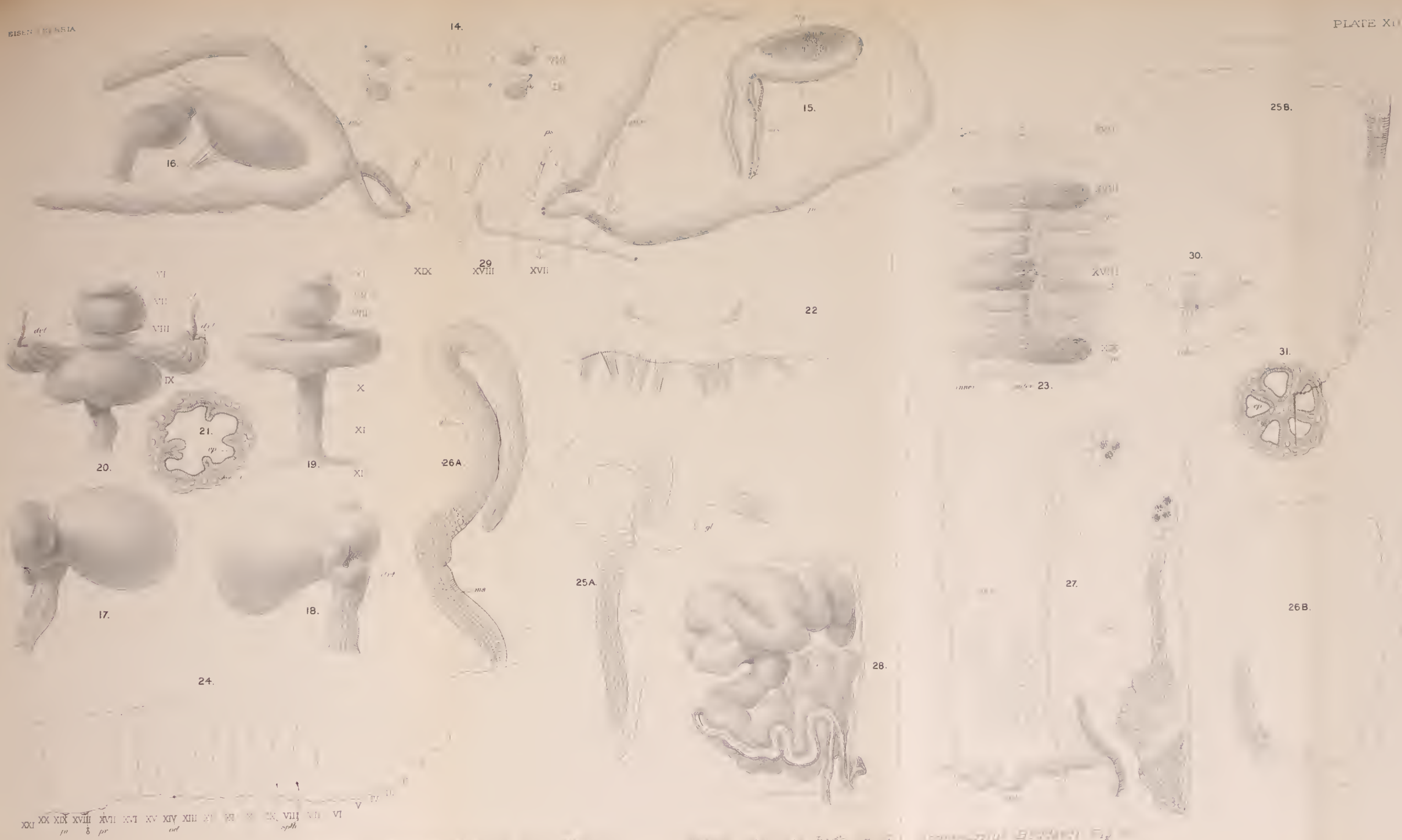

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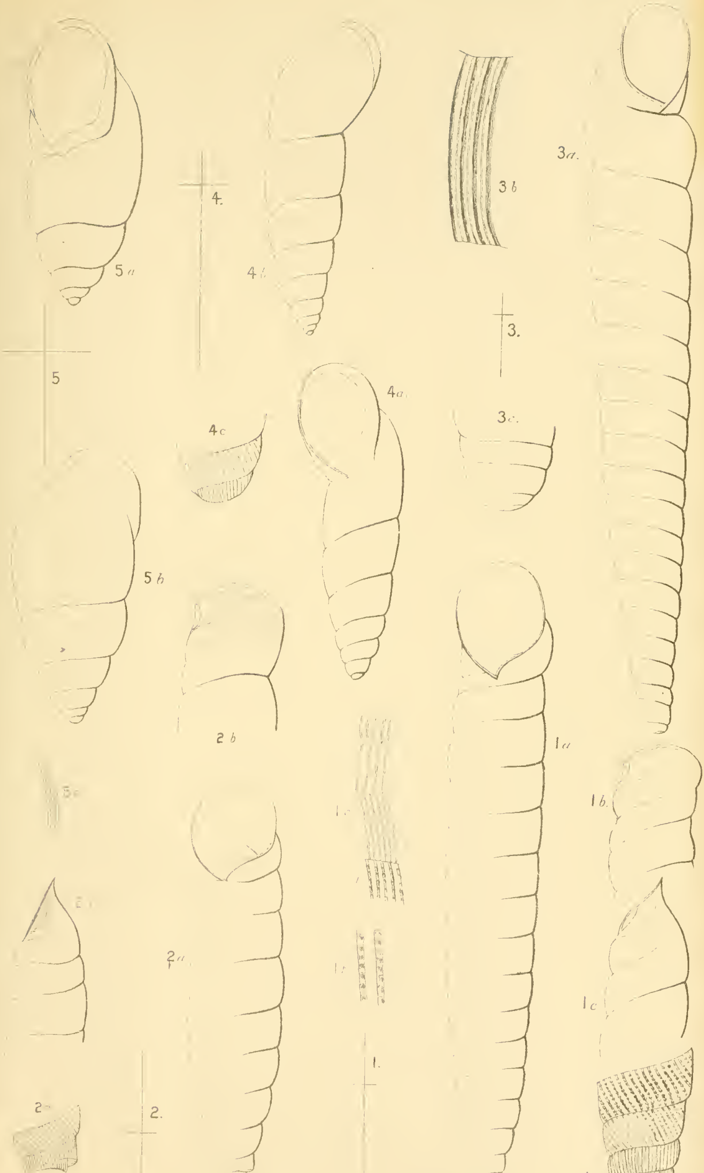

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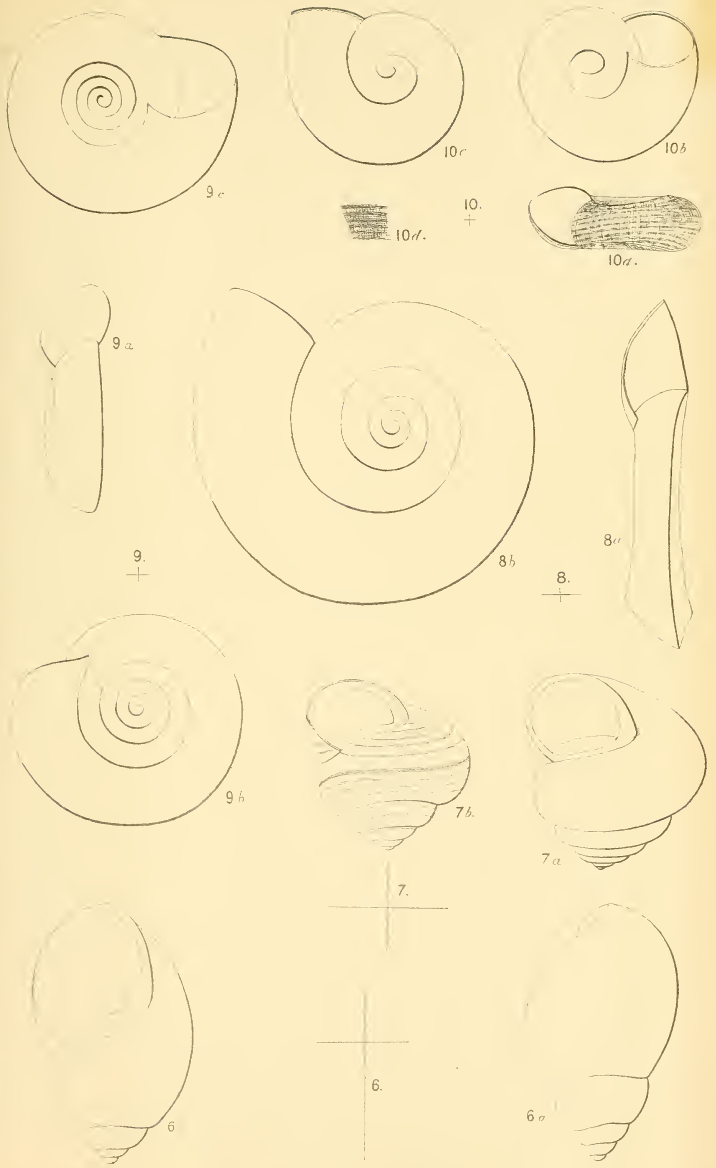
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Sixth Report.
State Museum of Natural History:
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History, 1840–1890.
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Annual Report of Curator, 1888–89.
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Natural History Survey of Illinois, vol. i, Ornithology.
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Seventh Annual Report, 1889.
Report, 1889, Dec.; 1890, Jan.–Apr.. June, Aug., Sept.
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Transactions, vol. xxi, Oct.–Dec.; xxii; xxiii, July–Nov.
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Annual Report of the State Mineralogist, ix.
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